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Pay No Attention to the Regulation Behind the Curtain: The Implications of the Return to Title IV (R2T4) Federal Aid Policy on Time to Degree

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PAY NO ATTENTION TO THE REGULATION BEHIND THE CURTAIN: THE IMPLICATIONS OF THE RETURN TO TITLE IV (R2T4) FEDERAL AID POLICY ON TIME TO DEGREE

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Federal aid programs and their effect on student persistence, stopout, and completion have long been studied, but current literature does not fully capture the temporal nature of these programs due to insufficient methods, imprecise data, or both. Using event history methodologies, I leverage a unique level of access to data at a public four-year, research intensive university to explore how the Return to Title IV federal aid withdrawal policy, one of the most prominent yet understudied aspects of federal financial aid policies, influences time to degree. The treatment of this policy is associated with a 58.6% reduced risk (reduced conditional probability) of completing a bachelor's degree at the home institution, and a 64.4% reduced risk of degree from any four-year university.

Keywords: federal aid policy, *financial aid, persistence, degree, time to degree*

To my role models
who instilled in me the commitment and perseverance needed for a successful journey

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CHAPTER 1: OVERVIEW OF THE STUDY AND PROBLEM

Federal aid programs, designed to minimize financial barriers and promote student success (Fuller, 2014), have long been studied to determine their policy implications and effect on student outcomes (Alon, 2011; Dynarski & Scott-Clayton, 2008; Mendoza et al., 2009; Paulsen & St. John, 2002). These programs exist by federal statute and are regulated by the Department of Education (Federal Student Aid, n.d., Federal Student Aid, 2017). Among federal financial aid policies found to influence college completion, Return to Title IV (R2T4) is surprisingly absent from the research literature, and so its impact on student outcomes is not well understood. R2T4 policy requires financial aid offices to bill a portion of aid to a student if they do not complete an academic term (Federal Student Aid, 2017). The dearth of knowledge of the effect of R2T4 on time to degree is a result of several practical and methodological challenges, including the temporal nature and complexity of financial aid, self-selection bias of aid participants, and the difficulties in obtaining comprehensive and sufficient data sets (Alon, 2011; Chen, 2008; DesJardins, 2003; DesJardins & McCall, 2010).

Only more recently have financial aid researchers begun using longitudinal methods, and so until now questions have been limited to the effect of aid offered or received, for instance, rather than its timing or revocation. This fails to account for lagged effects of mid-term aid revisions as result of student enrollment decisions on persistence and degree completion. Thus, while the economic and social benefits of offered financial aid to students have been well documented, the effects of billed (reductions to) aid during a period of enrollment on degree attainment are unknown. This is problematic as financial barriers affect students' enrollment and persistence behavior in ways not captured by award amounts alone (Chen & DesJardins, 2010; Pascarella & Terenzini,

2005; Paulsen & St. John, 2002). These enrollment outcomes compromise students' long-term economic and social mobility. Without an understanding of the influence of changes to aid, there is a risk of maintaining poor policy and reproducing inequity. This study addressed the effect of R2T4 on a set of financial aid applicants, with an interest in its effects across incomes as financial aid programs were designed to assist those from disadvantaged financial backgrounds.

Prior studies have opted to use initial aid offered as opposed to accepted or disbursed aid, as the latter are confounded by background characteristic variables typically important in the study of treatment effects, known as selection bias (DesJardins, 2003; DesJardins et al., 2002). More specifically, receipt of aid occurs after students make decisions on what type and how much aid to accept, decisions often influenced by their socioeconomic, cultural, and social characteristics. Thereby they opt into treatment which results in selection bias. Researchers begin addressing selection bias, along with other complexities in the study of financial aid, through utilization of advanced time series methods, combining methodologies to estimate the probability of treatment, and evaluating longitudinal effects of aid by type and amount (Ishitani, 2006; Chen, 2008; Chen & Hossler 2017; DesJardins & McCall, 2010). However, access to detailed student aid data that provide sufficient repeated measures and smaller spans of time between observations is a significant barrier to uncovering the effect of adjusted aid at time of departure. The current literature drastically underspecifies how financial aid influences students' persistence and completion decisions, by not yet adequately accounting for the temporal nature of financial aid policy, either due to insufficient methods or imprecise data, or both. More precise causal estimates will inform colleges and policy makers on

how they can take action to address adverse effects of aid regulation for students after matriculation and during their studies.

In this study, I addressed many of these limitations by leveraging a unique level of access to data at a public research university as a result of a campus initiative to improve graduation rates. Specifically, this research considered how R2T4, one of the most prominent yet understudied aspects of federal financial aid policies, influences time to degree for students who are among those with the most to lose due to inequitable affects of the policy.

Federal Aid Withdrawal Policy (Return to Title IV)

Return to Title IV (R2T4) was part of the original Higher Education Act (1965) and is one of a multitude of federal aid policies intended to impose a level of institutional and student responsibility for taxpayer investment by billing aid to students who withdraw from the university (cease enrollment during an academic term). This policy is regulated by Federal Student Aid, an office of the Department of Education. This office conducts institutional performance reviews to determine compliance with aid policies and continues to place R2T4 in its top ten audit findings nationally (Prince, 2015). This is not surprising given it alone encompasses nearly 300 pages (or 25%) of the Federal Student Aid Handbook used by aid administrators to determine student eligibility (Federal Student Aid, 2017). In these common withdrawal scenarios, R2T4 requires institutions to calculate the percentage of aid earned based on the student's last date of attendance or activity, if the date falls prior to the 60% point of the term (Federal Student Aid, 2017). The institution then bills the student for the federal calculation of unearned aid, plus any other aid based on their state and/or institutional policies. The withdrawal determination date drives the percentage of aid billed to the student and can yield large differences

among those who withdraw from a term. The billing of financial aid is a significant barrier, particularly for low-income students as they have limited resources with which to pay these debts. They are prevented from returning and completing their education at their home institution as past due balances typically lead to blocked enrollment (T. Sanger, personal communication, January 28, 2019). They are also prevented from ordering transcripts and so cannot transfer credits to another institution. This process can affect students' ability to return, continue, and complete their education at any campus.

The direct effect of financial aid on degree completion is less clear than its indirect effect via persistence, or a student's continued enrollment (DesJardins & McCall, 2010). This may be due to how financial aid variables are defined in research studies, but it may also be that most studies tend to evaluate initial start of term aid as opposed to how aid is revised over time as result of student enrollment decisions. There have been significant advances made in student departure literature related to financial aid, including discovering the need to evaluate longitudinal effects of aid by type and amount and allowing for differential effects by student socioeconomic status (Ishitani, 2006; Chen, 2008; DesJardins et al., 2002). However, access to detailed student aid data has proven a significant barrier to uncovering the effect of adjusted aid at time of departure in past literature.

Degree Attainment and Time to Degree

Bachelor degree attainment, and more precisely enrollment time to degree, is of interest to public policymakers as it is used as an indicator of institutional and student performance. The Student Right to Know Act (1991) required that all Higher Education Act Title IV (federal student aid) participating institutions disclose their six-year completion rates. The Department of Education began collecting this data in 1997 via the

Integrated Postsecondary Education Data System (IPEDS) (Glenn, 2010). While degree attainment had increased over time across sectors of higher education institutions, the change has been very small (Cooper, 2017; U.S. Department of Education, 2018b). Some attribute this small growth to the IPEDS calculation, as it only accounts for full-time students who begin and end at the same institution (Glenn, 2010). Despite the great interest, research on financial aid and degree attainment remains scarce. This may be due to the frailty of sources like IPEDS, and it may also be the limited availability and access to holistic and robust data sets that include enrollment periods at more granular levels than what is provided in national surveys (A. D'Amico, personal communication, October 13, 2017).

There are conflicting results on the causal effect of different types of financial aid among the limited research on its influence on degree attainment and reducing time to degree. Lam (1999) found more timely degree completion for students with aid other than work-study, and others like DesJardins et al. (2002) found work-study as the most influential on timely degree completion. Conflicting results may also be a result of advancements in analytical methods. As methods improved, researchers like Ishitani (2006) recognized the importance of variation of effects over time and began utilizing event history methods to account for this behavior. Unlike traditional regression methods, this approach supports dependent outcomes, such as stopout (students who withdraw but return in the observation period), dropout (students who do not return in the observed period), and graduation (Allison, 2014; Box-Steffensmeier & Jones, 2004). Event history methods opened the door to more robust evaluation of the dynamic and complex nature of student enrollment behavior.

The Role of Financial Aid in Promoting Degree Completion

Degree completion has been shown to greatly improve odds of upward economic mobility (Pascarella & Terenzini, 2005). However, students have unique challenges based on their economic backgrounds. Students from financially disadvantaged backgrounds experience social and cultural challenges based on the type of university they attend when the wealth gap is more apparent. They are less likely to attend elite universities given their sensitivity to cost; this behavior is a reproduction of existing economic and social class distributions and creates barriers to their participation in higher education (Paulsen & St. John, 2002). If they do apply and enroll in an elite institution, the wealth gap can lead to feelings of inadequacy and deficiency (Aries & Seider, 2005) which can increase their odds of stopping out (Paulsen & St. John, 2002). Likely a result of dominant social structures, low-income students are predisposed to lower college aspirations than students with greater family financial strength (Paulsen & St. John 2002). Social and cultural barriers influence student behavior prior to enrollment and persist throughout their career if they attend, including decisions on college choice, nutritional needs, prioritizing work over class time, and sacrificing campus engagement opportunities (Soria et al., 2014). These decisions have immediate and long term affect on their chances of obtaining a degree.

Research has clearly shown that while low-income groups are at a significant disadvantage when they enroll in college because of their backgrounds (Soria et al., 2014), financial aid has shown to moderate or eliminate these effects (Chen & DesJardins, 2010; Coria & Hoffman, 2016). These students are more responsive than their peers to shifts in tuition costs in choosing to depart from or persist through college (Chen & DesJardins, 2010; Pascarella & Terenzini, 2005). They weigh costs versus

benefits based on their perceptions of college price, financial aid, and unmet need which they believe will require working or payment out of pocket (Witkow et al., 2015). Aid programs are a strong component of increasing odds of persisting for low-income students and reducing the likelihood of student stopout (Alon, 2011; Chen & DesJardins, 2010). While there is mixed evidence on the influence of non-need based aid (Stewart, et al., 2015), most researchers agree on the importance of financial aid in supporting student success.

The Complexity of the Financial Aid Process

While financial aid moderates the effects of income, students are challenged by the process for obtaining federal aid. It begins with the completion of the Free Application for Federal Student Aid (FAFSA), which collects information on the student and their family's demographics, taxed and untaxed income, and asset information (Federal Student Aid, 2018). The data is used to calculate the Expected Family Contribution or EFC. Federal aid is assigned based on financial need using the EFC and the cost of attendance of the institution. Aside from financial need, each aid program had different eligibility requirements based on several factors, including dependency status, class level, percent time enrolled, and minimum academic progress requirements which may change year to year (Federal Student Aid, 2018). These criteria are required to be disclosed by campuses, but the volume of information is challenging for students to navigate, especially for underrepresented and non-traditional students (Campbell et al., 2015). This creates an air of mystery around how to qualify for aid and a lack of understanding of the financial ramifications of failing to meet other non-financial criteria. Empirical evidence demonstrates that the complexity of the aid application process, including duration, terminology, number of questions, and lack of prompt results are

barriers to enrollment (Bettinger et al., 2009). Dynarski and Scott-Clayton (2008) argue that the time and effort needed to complete the FAFSA deters low-income families from filling it out. This reduces the value of the aid for these families as they are unaware of their eligibility, reducing their odds of going to college.

However, application is only the first step to obtaining and maintaining federal aid. Once the application is completed, students have the possibility of being selected for federal verification; this process requires they submit tax transcripts and other information to their campus financial aid offices increasing the time to receipt of an aid offer (Federal Student Aid, 2017). The first information they receive on cost is typically the sticker price as opposed to the net cost after aid (Bettinger et al., 2009). Sticker price is the published cost of attendance and net price is cost after gift aid is assigned to the student, gift aid typically provided based on financial need as determined in part by the FAFSA application. The delay between application and receipt of an aid offer can affect students' belief regarding whether they can afford to attend college with their limited initial information (Darolia, 2013; Dynarski & Scott-Clayton, 2013). Thus, financial aid has significant positive effect on student enrollment and success for low-income students, but this is contingent upon these students and families understanding the aid process and their true net cost.

The complexity of the financial aid process continues throughout students' undergraduate career since they must reapply for the FAFSA each year (Federal Student Aid, 2018). The annual collection and verification of financial information is intended to maximize aid benefits and reduce misappropriation. However, Dynarski and Scott-Clayton (2008) found that the complexity of an annual application does not improve the targeting of aid when accounting for administrative and student costs associated with the

process. Instead, the evidence shows the complexity creates barriers for low-income students in their access to and success in higher education.

The substantial amount of information on program eligibility can be overwhelming for students to navigate. Student's enrollment, credits earned, periods of attendance in program, and several other non-financial criteria can change aid eligibility. Students receive information on the policies to maintain financial aid as part of the application process, but the unpredictable impact of the numerous program requirements is unclear until just prior or immediately following a student enrollment or academic choice, such as withdrawing from the university (Campbell et al., 2015). The complexity of the aid process has detrimental effects to students' ability to continue their education and complete their degree.

Problem

Federal aid programs have narrowed access and persistence gaps (Stewart et al., 2015), but degree attainment continues to fall short. This is especially evident among students from low-income backgrounds who face unique challenges and continue to lag behind their more affluent peers, with about 14% completing a bachelors compared to 60% of high income students (Alon, 2011; Aries & Seider, 2005; NCES, 2018b; Paulsen & St. John, 2002; Witkow, et al., 2015). While barriers to degree attainment have been studied extensively, researchers have primarily focused on identifying the determining influence of student background characteristics, institutional selectivity and fit, the application process, or offered aid (Darolia, 2013; DesJardins et al., 2002; Dynarski & Scott-Clayton, 2008; Flynn, 2014; Gershenfeld et al., 2016; Stater, 2009). Little attention has been paid to the systemic barriers created over time, including federal policy that can change financial aid in the middle of a term based on student enrollment decisions

(Federal Student Aid, 2017). The intense public focus on degree attainment suggests a need for understanding how changes in aid interact with student outcomes, especially if there is risk these policies extend the amount of time it takes to complete a degree.

Research shows low-income students are more sensitive to changes in aid and net cost regardless of their academic strength, a factor that arguably does not change once enrolled in college and pursuing a degree (Chen, 2008; Chen & DesJardins, 2010; Pascarella & Terenzini, 2005; Soria et al., 2014; St. John, 2006). While financial aid has been shown to moderate the effects of income on degree completion, there is still a lack of information on how changes to aid influence time to degree and degree attainment among these students (Paulsen & St. John, 2002). This absence of inquiry is not surprising given the limitations of publicly available data that often do not have the necessary detail or precision to effectively capture these effects across time or across institutions. Federal privacy laws largely restrict access to student level financial aid data (Higher Education Act, 1965; U.S. Department of Education, Privacy Technical Assistance Center, 2017). Thus, financial aid studies have suffered from limited access to sufficient data and from challenges inherent in evaluating a treatment with competing outcomes and endogenous variables (Chen, 2008; Chen & Hossler, 2017; DesJardins, 2003). These challenges have left a gap in understanding how common shifts in a student's enrollment can trigger financial barriers, extending the duration of time to degree and derailing odds of completion. DesJardins and McCall (2010) claim that student departure greatly reduces odds of graduation and increases the chances of future stopouts should they return to higher education, but little research exists to explain how this occurs and how government structures may contribute to this phenomenon. There is

risk of maintaining policy that may further exacerbate existing achievement gaps given the greater sensitivity of low-income students to aid changes.

A large part of the discussion on accountability for federal aid dollars focuses on student degree attainment and institutional performance, often relying on mean graduation rates (Glenn, 2010); however, little research exists which determines how federal aid regulations interact with these outcomes. The Return to Title IV (R2T4) policy triggers the billing of financial aid, which has implications for students' ability to return and graduate. This gap in knowledge may inadvertently reproduce economic and social disparities via an uninformed R2T4 policy for students who already lag behind their peers in timely degree attainment and economic buying power. Understanding how the application of a policy influences student time to degree and completion will illuminate its influence on student success. Educators and policymakers must understand how accountability in the form of a policy plays out over time, including how it does or does not address national completion goals and closing equity gaps, if they are to design or revise educational policy which meets public interests.

Purpose

The purpose of this study was to analyze the influence of R2T4 treatment (billing of aid) on student degree attainment and time to degree at a four-year public university. Given the varied tuition refund policies across colleges, a general assumption is made that evaluation of a federal aid policy is best done at the institutional level. I focused on this four-year university as students who matriculate as freshmen are admitted to a bachelor's level program. Four-year public colleges accounted for 67% of the total enrollment in the fall of 2016 and had a 6-year average graduation rate around 60% (U.S. Department of Education NCES, 2018b), making it important to understand how federal

aid policy may challenge student success efforts and impact completion rates at these institutions. Specifically, I evaluated the differences in degree achievement and time to degree among first-time freshmen federal aid applicants across several years, with an interest in the policy effects across incomes. Though first time freshmen do not account for all degree attainment, focus on this cohort ties to a group of interest in national surveys.

As a result, this study provides insight into the consequences of public policy on student degree attainment, including framing context for how financial aid improves student academic outcomes, but how these effects are moderated by the complexity of aid programs (Paulsen & St. John, 2002). The goal of this study was to understand how aid policy, which changes aid within a term, influences time to degree and degree attainment. This study advances upon past research by addressing intra-term aid changes and their effects across time. This was achieved using an institutional person-period data set that contains more granular spans of time between observations and more detailed financial aid and enrollment data, including billed aid within a term and enrollment tracking across institutions. This provides an understanding of how federal aid policy may contribute to and reproduce social and economic disparities.

Research Questions

The gravity of policy effects on student opportunity is at the forefront of this study, which evaluated outcomes for the 2006 through 2011 first-time freshmen cohorts of FAFSA applicants at Golden Mountain University. Using event history methods, this study analyzed the effects of the Return to Title IV (R2T4) policy on time to degree attainment at the initial institution, as well as completion at any four-year university. Evaluating outcomes for a sample from a four-year institution provided a base set of

controls regarding motivation for a four-year degree, admissions criteria, as well as provided a robust amount of student level data. Additional reasoning is described later in this section. Controlling for student background, pre-college preparation, financial aid received, and college performance variables, the following questions guided this inquiry:

1. Do amounts billed students as result of the R2T4 policy vary across incomes and across time?
2. For those who withdraw, how does the amount of billed aid as result of R2T4 affect time to degree and degree completion at Golden State University (the home institution)?
3. Of those students who withdraw from the home institution, how does the amount of billed aid influence their time to degree and degree completion at any institution?

By answering these questions this study addressed the potential effects of federal aid policy on the attainment levels of students, including how this varies across income groups. This shed light on how policy, a social and political system of control, can move or constrain economic mobility and provided an understanding of the effectiveness of aid programs as tethered to its administration.

Delimitations

The follow detail decisions I made as a researcher on this project to support study reliability and internal validity. I considered how economic and institutional changes may impact my findings and affect the validity and reliability of results. The market crash of 2008, for example, had an economic impact at the time which may influence my results given students who begin attendance may withdraw and not return in pursuit of income. Students' departure may not be due to the federal aid policy, but due to greater economic

opportunity as employment opportunities rose again. While there are events outside of the control of the study parameters, the following decisions were made to help control for other extraneous factors which could impact the results.

I made decisions on research design with three principal considerations: 1) evaluating the influence of an aid policy which changes aid over time ultimately requires a model and data which can be assessed over more granular periods of time, 2) students who withdraw from school are more likely to experience subsequent stopouts, so I considered fixed effects based on the number of withdrawal episodes to address different group frailties, and 3) the R2T4 policy affects disbursed aid only by percentage, so to understand the influence of a financial aid bill we need to understand the aid disbursed. Aside from decisions made prior to data collection, I also conducted several statistical tests which informed final model design (See Appendix K**: Data Decisions**).

This study is further delimited by addressing the outcomes of the aid policy at a single public four-year research intensive institution, hereby referred to as Golden Mountain University (GMU). The focus on one university addressed several pitfalls identified in past financial aid policy research, including the temporal nature of financial aid and endogeneity (Alon, 2011; Chen, 2008; DesJardins & McCall, 2010), as well as controlling for varied tuition policies which exist across institutions (Carlson, 2013).

In this study I examined the effects of a federal policy on time-to-degree and degree attainment. In order to understand the problem I needed focus on one area determined to hinder an individual's odds of moving between social and economic classes. I recognize there are many regulations which can change a student's aid, but chose R2T4 as it imposes a wide variation of billed amounts of aid and represents one quarter of the Student Aid Handbook, the guide used by aid offices to administer

financial aid. This substantial representation in this handbook and lack of literature on aid policies made R2T4 an ideal policy to examine. This included an interest in the effect of R2T4 across incomes as past research clearly identified interactions between income and financial aid.

I included six cohorts of first-time freshmen, including those who started in the fall of 2006 through 2011 cohorts at Golden Mountain University to increase sample size of students who began enrollment more than six years ago, the federally defined normative time to degree. While each cohort starts in different base years, the difference between 6-year and 8-year graduation rates is miniscule, at 1 percentage point for the last cohort that was tracked at Golden Mountain University via the College Navigator (U.S. Department of Education NCES, 2018). This supported inclusion of cohorts up through year 2011, a minimum of an eight year time span to September 2019, the end date of the study. Reviewing time beyond six years was important as only about 60% of students complete their bachelors within this federally defined normative time to degree. While students can only receive federal aid for a bachelor's degree a maximum of 6 years, this maximum is tied to enrollment time; yet, bachelor's degree attainment rates are reported by calendar time from student entry. Students who withdraw from the university are likely to have calendar time lengths which extend beyond the six years, and it is important to understand both how the aid policy may influence enrollment time and how it may extend calendar time.

Additionally, the inclusion of cohort years 2006 through 2011 covered a period of standardized application of the Return to Title IV policy (R2T4). In 2012, the institution adjusted its application of the policy to allow for startup costs (expenses typical of new students, such as technology, clothing, etc.) to be included in the total cost for a student in

their first year, effectively reducing net bills for first time students if they withdrew at any point during their first year of enrollment. As the R2T4 policy affects disbursed aid, cost and level of aid factor into the time to degree analysis. This again supported the inclusion of cohort years up through 2011, but exclusion of later cohorts.

Definition of Terms

This paper focuses on federal aid policy, but "financial aid" may generally include all forms of federal, state, institutional, and private aid. As the federal withdrawal policy affects all sources of aid, "financial aid" is used throughout to refer to all grants and loan assistance, such as Pell Grant, Supplemental Educational Opportunity Grants, Federal Direct Stafford Subsidized and Unsubsidized student loans, Federal Parent PLUS loan, state and institutional grants.

Defining low-income

While students of all income levels are included in order to properly address the research questions, the rationale behind this study includes a particular interest in the effects of the aid policy on low-income individuals. Income groups are defined by Area Median Income (AMI) publication by the California Department of Housing and Development (2011), the earliest available data which falls in the study period (Campora, 2011). This index splits out groupings as follows:

<u>Income groups</u>

0= Moderate/High income (Total Income (TI)>57,900)

1= Middle Income (46321<TI<=57899)

2= Low Income (28951<TI<=46320)

3= Very Low Income (17371<=TI<=28950)

4=Extremely Low (TI<17370)

While income groups change marginally by year and by family size, parsing students into by-year groups would complicate interpretation for a model which already evaluates the influence of income on time to degree.

Withdraw(al), stopout, and system departure

Withdraw(al) refers to students who formally petition to leave the university during an academic term where they were enrolled in credits. This term is used for both students who leave and return, and who leave and do not return in the observation period. References to stopout indicate a student withdrew from the university but returned to college in a subsequent term. System departure was used to signify a student who left the university without degree. These terms were used in the literature review when referencing work done by other researchers who focused on this type of withdrawal. While differentiating the types of withdrawal is important to understanding persistence, the focus of this study is on the effect of a policy that impacts all types of withdrawn students. As such, the term withdraw (al) is primarily used throughout in relation to the conceptual underpinnings and results of this study. However, the methods, as explained in Chapter 3, operationalize and account for both temporary leaves (stopout) and permanent leaves (withdrawal) in the data set.

Significance of this Study

Completing a college degree improves an individual's job market outcomes and earnings potential allowing movement between social and income classes (Pascarella & Terenzini, 2005). This individual benefit translates to national economic growth and prosperity by reducing net potential access to social services and increasing the tax base via increased employment rates. However, less than 60% of public college entrants in the United States complete a bachelor's degree within 6 years (U.S. Department of Education

NCES, 2018a), with lower rates of achievement evident for low-income students regardless of their academic strength (Ishitani, 2006; Soria et al., 2014; St. John, 2006). This study contributes to financial aid and persistence literature by exploring how R2T4, a federal aid policy, influences student outcomes. In particular, I evaluated how it affects time to degree using student data from several sources, including the National Student Loan Data System, National Student Clearinghouse, and Golden Mountain University (GMU). The study design, richness of the data, and foray into evaluating mid-term aid changes more acutely defines the relationship between federal aid policy and time to degree, as well as provides insight into the deleterious effects of regulation on access programs.

This study used Chen's (2008) heterogeneous approach for research on student departure behavior. Though this framework is designed for understanding the influence of aid on student departure, its tenets of incorporating variables found to influence student enrollment behavior from a cross section of theories are applicable to this study. Further, it predicts that students of lower financial means have a greater sensitivity to aid changes. Past works have addressed changes in aid at start of terms or on an annual basis (Chen & Hossler, 2017; Davidson, 2014). However, this study capitalized on changes in aid within and between terms, testing Chen's (2008) hypothesis on low-income student sensitivity, by using amount of billed aid to determine influence on persistence and completion outcomes.

Another key contribution of this study to the field of persistence and completion research is its evaluation of outcomes in relation to changes in financial aid. Using detailed financial aid data and advanced time series methods, this study addressed the effect of intra-term aid changes on time to degree and degree attainment. Past research

has primarily focused on the beginning or early part of the college pipeline due to data limitations (Bettinger et al., 2009; Chen, 2008; Chen, & St. John, 2011; DesJardins et al., 2002; Ishitani, 2006). The results of this study more acutely discern heterogeneity of the effects of the Return to Title IV (R2T4) policy across time and across incomes, by incorporating the volatility of financial aid. The results inform issues facing legislators and policy makers on the effectiveness of R2T4, including any unintended consequences which must be addressed through statute or regulatory improvements.

A common challenge of financial aid and persistence research is sacrificing the specificity and robustness of an institutional data set with the tracking of student mobility present in national surveys. Data privacy laws are one barrier that prohibit the tracking of students across institutions in some states and have prevented this analysis in past research that uses institutional data (DesJardins & McCall, 2010). The current study addressed this gap through access to and use of data from the National Student Clearinghouse, a hub which tracks individual college student enrollment and completion across institutions. I present two models, one which captured students' enrollment and completion at GMU, and the second using the same sample and tracking enrollment and degree completion at any institution. The richness of the institutional data combined with data on student mobility provides a holistic response to the effect of the R2T4 policy and informs institutional leaders of challenges they can address through additional retention efforts.

Federal regulations serve to establish responsibility for taxpayer dollars by dictating how financial aid offices award and revise aid based on student financial need and enrollment. The R2T4 treatment is one such policy that protects public investment by collecting on portions of students' opportunity (financial aid). What level of opportunity

debt prevents students from completing at their home institution? What level of opportunity debt drives them away from college for good? These are important questions and the answers serve future federal aid policy discussions, including the reauthorization of the Higher Education Act, where change can take place to address a poorly designed statute. Individuals' education levels and ability to complete may forecast how economic and political structures serve to reproduce the status quo.

Organization of the Study

This study provides insight relevant to current discussions on accountability and performance, on ways current aid regulations may counteract the founding principles of federal student aid and adversely affect students with the greatest need. Chapter two provides background on the state of accountability measures in higher education finance, as well as a review of the literature on the relationship of different sources of aid and effects on enrollment, persistence and attainment. Chapter three lays out details of the methodological approach including definitions of terms, formula for how the model operates, covariates used and how they were operationalized, as well as the analytical approach for each research question. Chapter four details findings for the two models, including descriptives of the population and sample, nonparametric analyses, and the output of the final event history analysis. Finally, chapter five contains discussion on the findings and provides information for policy makers and higher education administrators on ways financial aid policies can be modified to provide equitable balance between opportunity and responsibility for students of varied income backgrounds.

CHAPTER 2: LITERATURE REVIEW

Federal aid policy drives the awarding and revision of financial aid to students, but the effect of changes in aid over time throughout students' time in college are largely absent from the literature. The following literature review provides background on the larger issues at play with socioeconomic mobility, and to present the nature of aid policy research from access through graduation. Financial aid focused research has primarily been situated in economic frames, but persistence and attainment studies arguably perform more robust evaluation of aid effects as they incorporate larger frames of understanding the student as a whole. As there is relatively little theoretical understanding of how changes in aid during enrollment affects degree attainment, I review literature which has addressed the role of financial aid in student behavior (including college choice and access), as well as frameworks used historically to explain student persistence and degree attainment behavior.

The first section of this chapter provides context for this study by reviewing the transition of public sentiment on higher education finance and its affect on student success, resulting systemic and social barriers to the mission of financial aid programs, and closes with a discussion of frameworks used in the study of aid policy. Though this study evaluated the effects of Return to Title IV (R2T4) on all students in the identified sample, past research has determined financial aid changes have differential effects across incomes, primarily students from low-income backgrounds. As R2T4 deals with imposing financial penalties, sections of the following literature focus on the implications of aid on this sub-group. I follow this with a section on contributing factors that are important to account for in studying student departure and risk of departure, the

relationship between financial aid, enrollment and degree attainment. Lastly, I close with a summary and limitations of the literature.

The Privatization Movement

The first Higher Education Act (1965) was an output of the political climate of the time, which supported expanding opportunity to students from economically disadvantaged backgrounds by establishing federal student aid programs. Higher education was seen as a class equalizer in the mid-20th century and prompted states to keep tuition costs low to promote accessibility (Chen & St. John, 2011), but national reports such as the Carnegie Commission on Higher Education (1973) prompted a rethinking of the student and family role in subsidizing the cost of education. This sparked the privatization movement, resulting in a shift of public opinion from support of public services to individual responsibility (Chen, 2008; St. John, 2006). This shift jeopardized access to higher education for those from low-income backgrounds given their limited purchasing power and the increasing college costs as states reduced funding. Federal student aid programs increased to balance out access and affordability for lower income students, but this expansion was shifted from grant to additional loan programs beginning in the 1980s (St. John, 2003). The presidential administration at that time considered increasing costs to be an institutional ploy to pay for wasteful practices with additional federal dollars.

The reduction in grant aid hindered college enrollment for low-income students, who may have been first generation or who considered the option of taking a loan as too high a cost to pursue their degree (Dynarski & Scott-Clayton, 2013). The expansion of student loans primarily benefited middle income students (Chen & St. John, 2011), which hints at a setback in equity for low-income groups. St. John (2006) argued that education

policies, such as those sparked by the privatization movement, may reproduce inequality by widening gaps in opportunity. These gaps have widened over the last two decades as resistance to increased taxation created competition for limited state funding (Castleman, et al., 2015; St. John, 2006). This competition for state funds led to greater financial investment to fall on individuals and families in a number of states, a concerning trend for long term educational access, equity and socioeconomic mobility.

More data, more problems. The trend towards privatization sparked tension between aid for access to low-income students and aid for affordability to middle-income families (St. John, 2006; St. John, 2003). While the public still believes higher education is the best chance for an individual to achieve greater financial and social mobility, there is growing concern regarding burgeoning costs and the quality and marketability of education provided (Lederman, 2017). This drove greater transparency (including mandated reporting) on the part of colleges and universities in response to the questions on the appropriateness of public subsidies to higher education (Chen, 2008; Cohen & Kisker, 2010; St. John, 2006). The substantial data being reported to federal and state agencies results in little information gained since drawn conclusions must take into account the context of the type of institution and of individual state political climates (Bidwell, 2018; Heck et al., 2014). However, public colleges are motivated to comply as they rely on public support via tuition and fees, state appropriations, and financial aid to fund operations (Wellman, 2008). Still, state funding declined over the last few decades, trickling down cost burden to students via increased tuition (Heck et al., 2014), and calling into question the benefit of accountability measures and their consequences.

Goal complexity. Federal aid policy is formed by Congress, a political body influenced by current public interest in the accountability of both colleges and students.

Though the federal government does not directly finance institutional operations like states, they do control eligibility to administer aid programs via the Federal Student Aid Office (Federal Student Aid, n.d.). Over the years additional statutes and regulations have been placed on institutions which are loosely related or unrelated to aid administration (e.g. Clery Act crime statistics, cohort default rates, etc.), but which are required of schools who participate in Title IV (Student Assistance General Provisions, 2017a). Violations typically result in fines, public disclosures of institutional performance, and in extreme cases, loss of Title IV eligibility for repeated violations (Student Assistance General Provisions, 2017b). Financial aid programs are a significant revenue stream for schools who enroll students of more diverse socioeconomic backgrounds. In this environment, colleges and universities are responsible for serving as both gatekeeper of policy to ensure continued Title IV participation, and as advocate for student needs. The complex and robust regulations and metrics involved in federal aid has generated concern about competing priorities (Rutherford, 2016), including the pull between access and affordability.

Accountability spurs added legislation and regulation, producing a web of competing institutional priorities that negatively affect graduation and retention rates (Rutherford, 2016). These rates translate to student withdrawals, increasing odds of failing to complete a degree (DesJardins & McCall, 2010). This jeopardizes students' long term economic buying power, a facet which can perpetuate social and financial inequity (Becker, 1994; McMahon, 2009). Additional aid regulation is also associated with increased administrative costs to institutions and increased complexity for students which may not produce large benefit or the intended benefit of the policy (Campbell, 2015; Davis et al., 2012; Dynarski & Scott-Clayton, 2008). Regulations are imposed to

establish uniform adherence to the law, but evaluation on potential implications to student outcomes is consistently overlooked by those generating public policy (St. John, 2006).

Social/Political Barriers in the Study of Financial Aid

Federal student aid is set up as a system intended to reduce social and economic inequality, which is problematic as it is positioned in and defined by the same structure that produces inequality. Social and political barriers may mitigate positive aid effects, thereby masking their true net benefit to low-income students (Kim, 2012; Rutherford, 2016). These barriers take several forms, including time-varying controls, like regulations that rely on performance metrics in an effort to balance access and accountability. As an example, some aid regulations require the adjustment of aid based on academic progress or student enrollment changes at varying points during the student's career (Federal Student Aid, 2017). The time-variant nature of these aid changes complicates research that seeks to understand how a social benefit is or is not significant for individual social and economic mobility. For the few studies that address how aid differs across time, the observation point relies on start or end of term or academic year (Alon, 2011; Chen & Hossler, 2017; Chen & DesJardins, 2010). This produces aggregate totals and fails to assess changes in aid between observations.

While there is a gap in understanding how the volatility of financial aid affects student success, the literature does convey that other complexities of federal aid programs are barriers to access, persistence, and graduation for low-income and underrepresented groups (Dynarski & Scott-Clayton, 2013). For example, lack of early, clear, and consumable information on college cost and financial aid deters some students from enrolling in college and incites others to enroll in lower sticker price schools which may

not match their academic ability (Bell, et al., 2009). Financial aid language is not always accessible to families with lower education levels and marginalized social backgrounds (Bell, et al., 2009; Dynarski & Scott-Clayton, 2013); it is socially constructed and is informed by federal aid regulations which do not cater to these students and families. This places marginalized groups at a disadvantage in navigating the aid application process. Students' ability to navigate the aid process and their perception on college costs influence their decision to pursue postsecondary education and their college choice (Chen & DesJardins, 2010; Dynarski & Scott-Clayton, 2013; Pascarella & Terenzini, 2005), but federal aid has been shown to moderate some of these hurdles (Paulsen & St. John, 2002).

The study of social and political barriers in financial aid demonstrate an understanding of their practical effects to students, but show a gap in understanding levels of effects over time. The research questions asked also place a heavy burden on student characteristics or institutional response to aid policies, but do not address inherent contradictions of rules formed in a biased system. Aid policy for example, is designed at the highest level of government, an entity operating on values of efficiency and historical investment in social progress (Bolman & Deal, 2013; Shafritz et al., 2016). These values are contradictory. While researchers have identified the issue of federal aid policy, they have not captured the full picture of the barriers it poses throughout the aid life cycle. Educational policy makers and legislators need to reconsider how accountability measures which result in adjusted aid may negate positive effects of aid programs across high-risk income groups, if they are to design effective and equitable aid policy (Kim, 2012).

Frameworks Used in the Study of Aid Policy

The inherent complexity of financial aid has resulted in a transition of theoretical and conceptual frameworks used to evaluate its influence over time depending upon the unit of analysis and advancements in understanding higher education. While this study examines the influence of federal aid policy on student achievement, it is important to consider the financial aid life cycle on student progress from access through graduation. This overview of the educational pipeline, including the trickle-down effect of policy effects on higher education systems, provides context for how researchers have continued to push boundaries in explaining challenges faced by students on their path to success. However, while resolving some methodological challenges, researchers continue to struggle to advance knowledge forward given access and data limitation issues.

Student enrollment behavior is a common outcome of interest in financial aid policy research, with studies drawing from economic or social and cultural frames. However, the most common financial aid policy research assesses higher education finance on institutional (college) access and completion measures (Connor & Rabovsky, 2011). Researchers have relied on resource dependence, political, or systems theory to understand the effect of financial aid policy and influence on institutional behavior. This focuses on degree attainment from a systems level, but this same focus on policy effects is absent for the student level. This leads to content focused on performance outcomes for schools, but fails to address the real world consequences of aid policy for the individual student. Yet, student enrollment behavior and financial aid are inextricably linked. Just as it is useful to understand how systems interact and indirectly influence student enrollment patterns, it stands to reason that the same approach can and should be leveraged to understand the effects on students' decisions whether and when to stop out

or return. Thus, the remainder of this section focuses on frameworks utilized to explain student persistence and departure behavior, and how academia evolved over time to include the relationship of finances and financial aid to individual student enrollment behavior.

Perhaps the most prevalent theory historically in student departure and persistence literature is Tinto's (1975, 1987) interaction and integration theory. In this framework, student persistence and departure is rooted in the interaction between student's individual and family attributes (including academic intent and motivation) and their experiences with their college. The idea is that students are more likely to persist if their personal and familial attributes are able to meld and be supported by their college environment. However, it fails to account for institutional variation and approaches academic success as the responsibility of the student to adapt to their environment instead of vice versa.

Over the years, researchers have addressed the gaps in Tinto's (1975, 1987) theory by incorporating additional hypotheses on the influence of student pre-college attributes, perception of the tolerance of the college environment, support networks, and financial decision making into their frameworks. This includes Nora and Cabrera's (1996) student adjustment model that explains that student decisions to persist at a campus are linked to social and academic preparedness, their perception of the racial tolerance of the campus and ability to integrate. It also includes Becker's (1994) human capital theory that posits that individuals (students) will weigh the benefits of an education versus the cost of their investment of time and money when deciding to enroll, persist or depart. Each of these theoretical perspectives focuses on student decisions in relation to one aspect of their social or cultural identity. While each author added to the

understanding of student enrollment behavior, each frame is distinct and continued to be of narrow focus.

While Becker's (1994) human capital theory placed finances in the spotlight of higher education, St. John and Paulsen (2002) expanded upon this theory by developing the financial nexus model. This model considers the importance of finances on college choice, differentiated based on student social, economic and cultural background. They considered initial decisions and dispositions regarding costs and benefits as potential influence on later decisions to persist, recognizing how other characteristics of the student may moderate effects of financial aid. This theory advanced the field of student enrollment behavior by providing one of the earliest insights into how financial aid may factor into student choice. However, while this theory considered how college choice and decision to persist and graduate may vary by social, economic and cultural background, it focused on finances as dominant in decision making. The layers behind student enrollment behavior and the many factors aside from financial considerations led to calls for improved frameworks that could explain more of this complexity.

Building upon prior work on student achievement, Chen (2008) advocated for pushing the boundaries of research to explain why attainment gaps continue to exist and widen between disadvantaged groups and their more affluent peers. Traditionally, psychological, sociological, organizational, interactionalist, and economic theories have been used in student departure research (Chen, 2008; Braxton & Hirschy, 2005; Tinto, 1975). While each perspective gives insight into student enrollment and departure behavior, Chen (2008) argued that liquidity constraints, price elasticity, and debt aversion are concepts that can help discern the differential effects of financial aid across socioeconomic backgrounds. Chen coined this heterogeneous approach; it considers how

variables from each sphere of influence must be included in the conceptual model of understanding aid effect on dropout risk.

The heterogeneous approach improved on prior hypotheses by considering that student responsiveness to aid may differ not only by student group, but also by student over time based on individual sensitivity to cost. This conceptual framework represents the most recent holistic approach to understanding financial aid on student enrollment behavior. Chen (2008) also provides testable hypotheses to better understand "the role of financial aid in equalizing educational opportunities" (p. 222). Though this framework is robust, it cannot account for every variable of influence on student enrollment behavior. However, it does include factors found in past research as influential in its conceptual model and provides direction for evaluating causal relationships tied to financial aid. Of the several different frameworks used in persistence and attainment research, I used Chen's heterogeneous approach as it addresses several traditional schools of thought while incorporating students' price elasticity, a more specific concept with concrete implications on student behavior in the face of a policy which has financial repercussions. In particular, I included variables in my model based on Chen's framework of student stopout and enrollment behavior.

Empirical Evidence of Financial Aid on Persistence and Degree Attainment

As was mentioned previously, there was a shift of public interest from access to degree completion in regards to support of federal aid programs. Degree attainment varies significantly across income groups, with lower rates of achievement evident for low-income students regardless of their academic strength (Soria, Weiner, & Lu, 2014; St. John, 2006). Studies have shown that likelihood of obtaining a degree is influenced by factors prior to enrollment, including pre-college academic preparation, college

aspirations, parent education, etc., and that these factors vary by income, race and ethnicity (Cerna et al., 2008, Becerra, 2010; Ishitani, 2006; Lam, 1999).

Low-income students also face social and cultural barriers not experienced by their more affluent peers (Aries & Seider, 2005; Paulsen & St. John, 2002; Soria et al., 2014), such as resources which assist in understanding their true educational cost (Dynarski & Scott-Clayton, 2008). They tend to have less family resources to draw upon to help navigate the college application and enrollment process (Klasik, 2012), and may not be apt to vocalize their need for assistance. These behaviors persist throughout their academic career. Financial aid has been shown to moderate the effect of income, demonstrating the importance of these programs to improving socioeconomic equity (Gross et al., 2013; St. John & Noell, 1989).

Student Financial Aid Effects

Researchers have had mixed success on uncovering the true effect of federal financial aid on student achievement. The exception is its effect on access to higher education. There is consensus around the influence of financial aid programs as creating a path of equity of access to a college education. Students from lower socioeconomic statuses are, as would be suspected, more likely to have lower financial means prior to and during college (Witkow et al., 2015). Thus, these students are more likely to draw on and benefit from financial aid offers from campuses. Increased college enrollment is partially a result of federal need based aid, like the Pell Grant and subsidized loans, which have allowed greater rates of low-income students to attend college (Darolia, 2013; Kim, 2012, St. John, 2006; St. John & Noell, 1989). These programs provide a bridge for low-income students to have additional opportunity, but have not kept pace with rising institutional costs (Protopsaltis & Parrott, 2017; Stratford, 2013). Access

results are less than optimum given the declining purchasing power of federal grant, the shift towards loan, and low-income students' fear of borrowing. Still, these groups experience greater ability to attend college today due to financial aid programs.

In addition to access, research has explored student persistence, or a student's continued enrollment, and graduation. Both are typically explored together as using graduation alone is a poor measure of accountability and produces mixed results (Dynarski & Scott-Clayton, 2013). Stewart et al. (2015) found students who received financial aid are more likely to persist than students who did not receive aid, although loans have not been found to have as positive an influence on degree attainment as grant aid (Lam, 1999; Li, 2008). Gross (2011) and Museus's (2010) studies confirm the positive influence of aid, and determine that type of aid and timing reduce chance of stop out with varied level of effect across subpopulations. While financial aid reduces the likelihood of departure for low-income and traditionally underrepresented groups (Chen & DesJardins, 2010; DesJardins & McCall, 2010; Gross, 2011), researchers differ on which types of aid prove most effective and for which student sub-groups. For example, DesJardins and McCall (2010) found that all forms of aid reduce chances of withdrawal, but that loans are the only form of aid that directly influence odds of graduation. This contrasts with a study done by Goldrick-Rab et al. (2016) found the offer of additional grants increased odds of bachelor degree attainment. Other researchers drew different conclusions based on student ethnicity and income levels (Gross, 2011; Gross et al., 2013; Museus, 2010). While outcomes differed on which type of aid are most effective in having students persist and which reduced departure, the majority confirmed that aid contributed to student progress to degree after controlling for student background, pre-college academic preparation, and other key variables. The mixed reviews on the level of

influence of financial aid suggests there may be mediating factors which have yet to be observed and that detract from the initial momentum aid brings to at-risk groups.

Financial aid has also been shown to moderate the effect of high financial need on lower levels of academic achievement (Coria & Hoffman, 2016). This includes merit and need based grants, which have positive influence on GPA year to year supporting other works which find a positive relationship between aid and persistence (Stater, 2009). The magnitude of the effect of need based grant differs among researchers. Some find merit aid has a stronger positive effect than need based grant and others find need based grant to have a stronger effect in the latter half of a student's bachelor's career. The complexities of the aid system, including the various types of aid, institutions, eligibility criteria, and the temporal nature of aid assignment and revision, may be contributing factors to these varied results.

Institution Level Finance and Enrollment

While a majority of the financial aid literature covers effects on student outcomes, another body of literature details financial aid's influence on larger scale enrollment patterns at the institution level. This area of research illuminates the impact of the privatization movement, and the indirect cost to student outcomes. For example, institution type and cost of attendance have been found to differentially affect student enrollment (Kim, 2012). The institution's ability to administer federal financial aid can shape an incoming class, especially at higher cost institutions (Darolia, 2013). This supports the tenets of human capital theory and price elasticity which describe sensitivity to cost and individuals' weight of potential benefits of investment (Becker, 1994). Social, economic, and cultural capital of the student and their perception of their ability to access additional capital (including financial aid) via the university is a factor in their decision to

enroll at a campus. This perception of financial aid and cost is different across income levels (Kim, 2012).

The effect of aid on historically underrepresented and minoritized groups and their enrollment is moderated by a university's tuition and region (Montalvo, 2012). Some institutions provide a local or university grant program, dollars that reduce tuition cost, and which significantly reduce the likelihood enrolled students will transfer out of their baccalaureate program (Gross & Berry, 2015). Institutional aid has also shown to improve year to year persistence odds, with greater effects for men than women (Gross et al., 2007). While institutional aid programs vary, this is an important consideration for identifying interactions between university and federal aid programs and policies.

State Aid and Financing

Given the more direct involvement of states in financing higher education, it is unsurprising that state aid policy is a large research area. Studies have investigated the influence of state aid programs and institutional funding on student access, persistence and mobility. State grant to tuition ratios, for example, are associated with greater persistence rates across most public institutions in the United States (Chen and St. John, 2011), and they also reduce the likelihood of students transferring out of their initial college (Gross & Berry, 2015). Federal and state aid policy impact eligibility and availability of aid programs which influences student persistence (Stewart et al., 2015). State aid is especially critical for low-income students, where Kim (2012) found a positive relationship between state grant and enrollment in two-year and private institutions. Kim (2012) argued that increased state grant may also open access to any type of institution.

Researchers also explored the effect of state support to institutions in relation to student success. Increases in state funding per student at an institution are positively associated with six-year graduation rates (Heck et al. 2014; Zhang, 2009). The type of state political culture is a mediating variable for how appropriations are made to higher education, in turn affecting a university's production of degrees. Level of institutional expenditures have also been linked to improved persistence and graduation odds, though no effect could be linked to additional funding to student service offices like financial aid (Ryan, 2004). Individual level analysis and identifying mediating variables on graduation and other student success measures will help inform state legislators of efficient and effective policy. While this area of research poses additional complexity due to nesting of the unit of analysis, it expanded knowledge by exploring the effect of state action on student level behavior. It acknowledged the importance of higher level policy funding decisions and how these stream down and affect student achievement.

Federal Aid and Degree Attainment

As mentioned earlier in this section, most of the work on financial aid evaluates student level effects and issues of access, persistence, and retention, typically highlighting traditionally underrepresented student groups (Davis et al., 2012; Gross, & Berry, 2015; Paulsen & St. John, 2002; Seftor & Turner, 2002). There is also outlying literature on effect on college GPA and credits earned, but this work can only identify indirect effects on degree attainment (Coria & Hoffman, 2016; Stater, 2008). The research which exists on aid and its direct effects on graduation finds modest positive relationship (Jensen, 1984; Proudfit, 2014), but these results are from studies that are either very old or only explored in dissertation.

Studies which focus on federal aid typically evaluate the offer or receipt of federal aid types, often in consort with state and institutional aid. DesJardins and McCall (2010) for example, simulated the effect of different types of aid on stopout and re-enrollment by comparing actual aid to no aid at the start of a term of enrollment. Others compare federal grant and loan programs, finding they decrease likelihood of the student transferring out and positively affect persistence (Gross & Berry, 2015; Mendoza et al., 2009). Little exists on revisions to aid based on changes in a student's enrollment and the relationship to degree attainment. Researchers have noted difficulties in ascertaining robust outcomes and evaluating degree achievement due to the complexities of aid programs, different institutional and state contexts, data availability, and fluctuations in aid from year to year as result of annual application (Chen, 2008; DesJardins et al., 2002). This may be reason that some studies evaluate changes by simulating offers or elimination of federal aid programs to explore affects to underrepresented groups, an all or nothing approach which does not review changes in levels of aid (Davidson, 2014).

Federal aid administration and eligibility criteria geared toward targeting federal aid are critiqued as disenfranchising students with most need (Campbell et al., 2015). The robust number of questions and the level of language are reasons for the complexity. These questions are intended to collect information that feeds into the federal aid formula and produces the Expected Family Contribution (EFC), a metric which drives eligibility for types and amounts of aid (Federal Student Aid, 2017). Complexity does not significantly improve targeting of aid dollars, especially in light of student and administrative costs to manage these policies (Dynarski, & Scott-Clayton, 2008). Further, low-income students are more greatly affected as they are likely to miss key deadlines or fail to complete a step in this labyrinth process (Avery & Kane, 2004).

Limitations of the Literature

The literature covered a wide array of issues dealing with higher education finance and student outcomes, but there are several notable limitations involving study design and relevance to current public concerns. The first limitation is the lack of recent and robust evaluation of federal aid with degree attainment and time to degree as dual outcomes. Research has centered on access or persistence, outcomes tied to the beginning or middle of the undergraduate career. These points of inquiry are ill equipped to address current interests in degree attainment, especially for students with inconsistent enrollment. The few studies that have looked at federal aid and its influence on student achievement tended to place graduation as a dichotomous variable (Ishitani, 2006) or aggregate aid by type (Lam, 1999), potentially masking aid effects that vary over the student's academic career. Incorporating time to degree and parsing out aid in more detail is of greater benefit to understanding the nuance of aid over time.

The evaluation of effects typically relied on a snapshot of aid offered or received—a variable that is effectively treated as static in analytical models and typically tied to early points in a student's enrollment in a term. Using only aid offered or received fails to account for revisions to aid as result of changes in student enrollment, a critical consideration given that more than 40% of students who start at a four-year university in the United States do not complete within six years (U.S. Department of Education, National Center for Education Statistics, 2018b). Most of the works also assume aid has the same effect on the outcome over time, a limit which may be explained by lack of sufficient repeated observations in the data used. The number and time period of observations available can affect the accuracy of estimates for studies which incorporated

time as a variable. This limited window of observation includes the maximum six year period (or maximum of 19 terms) of national surveys.

Further, studies on financial aid have not considered student enrollment behavior in their outcomes. Chen and DesJardin's (2010) study is an exception, where they evaluated frequency of student stopout and interactions with time on odds of degree attainment. They found this behavior was moderated by financial aid; however, it only considered financial aid received annually and not changes to this aid by term as result of departure. It also only accounted for persistence as an indicator of the odds of degree attainment as opposed to using completion as the outcome. Other works simulated the effect of change in initial offer, receipt and presentation of aid (Davidson, 2014; DesJardins & McCall, 2002). While simulations of changes in aid availability provided insight into potential affects to students, they did not address current policy and its influence on actual student success outcomes.

Another common challenge in the literature is the same challenge present in most causal research, securing more precise measurements of covariates of interest from accessible data sets with large enough sample sizes to provide efficient and robust estimates. The precise amounts and length of observation of financial aid types are often challenging to secure, and researchers have used proxies or crude financial aid data in their models on the influence of aid on student success. While researchers can control for multiple independent variables, all studies have indicated difficulty in accommodating all possible influences on student behavior and choice, including interaction effects between variables. Two aspects of financial aid research that can be improved, while not avoiding measurement issues entirely, include accounting for complexity of the aid system by using more precise and repeated measures of aid by type and amount across time. This

addresses the frequency of change in students' aid benefits and obligations. In the next chapter I show how my study addresses these limitations by leveraging more precise, longitudinal data than is customarily available.

Summary

The literature provided context of mission and current status of the financial aid system. Federal aid was established as a class equalizer and is influenced by political agendas of those in power. Maintaining sufficient funding, access, and low institutional costs are efforts which have been influenced by the privatization movement. Low-income students face challenges to enrolling and succeeding in college, such as lacking the social and cultural capital to navigate the annual federal aid application process. The offer of financial aid has shown to mitigate some of these barriers. Though researchers continue to advocate for more robust theoretical frameworks, the study of financial aid has progressed significantly along with advancements in analytical methods and conceptual frames.

The literature reviewed provided mixed results on the effectiveness of financial aid programs, with authors taking note of the inherent challenges of evaluating these programs' influence on the student college pathway. Most confirmed the value of aid on access for low-income and underrepresented groups. They also confirmed the high complexity of the financial aid structure which impedes ability to evaluate its contribution to persistence and graduation. Researchers have commented on the difficulty in determining the influence of aid given the many competing variables which affect student behavior, including how some of these effects are lagged. The largest difference in the literature was the subject of the measured outcomes (e.g. individual student versus

institutional enrollment), how student success was measured, and recommendations for policy change.

Exploring aid policy is essential to understanding how it does or does not reproduce social and economic inequity. While prior research has substantiated the value of federal aid to access and improving persistence odds, little addresses aid administration and regulation on withdrawal and re-enrollment and how this may undermine the mission of financial aid.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

The purpose of this study was to evaluate the relationship between the federal aid Return to Title IV (R2T4) policy and time to degree for first-time freshmen. This chapter begins with an overview of the challenges and past solutions in the study of aid policy, followed by a review of the theoretical framework and guiding questions of this project. The second section of this chapter provides details of the research design, including the methodological and analytical approach selected for this study, description of data sources, key variables, and concludes with limitations and a summary.

Challenges in the Study of Aid Policy and Methodological Solutions

I explore below the challenges present in the study of aid policy in order to establish the rationale for the selected methods and analytical steps. As there are very few studies on time to degree for students who withdraw from a university, I review design considerations outlined in studies on student persistence and degree completion. This involves controlling for different variables, such as those tied to academic preparation, family background, financial strength, etc., which other researchers have found to explain some of the variance in student decisions to persist (Gross & Zerquera, 2015; Stewart et al., 2015). The main challenges in the study of aid policy are self-selection bias (endogeneity), omitted variable bias, the nesting of units of analysis, and the temporal nature of financial aid (Alon, 2011; Chen, 2008; DesJardins & McCall, 2010). In this section, I address how each of these challenges has been approached in past research, and the disadvantages of each approach in the study of R2T4 aid policy.

Self-selection and Endogeneity

Randomized controlled trials are the gold standard of causal inference, but are typically impractical for higher education finance studies (Light et al., 1990; Shadish et

al., 2002). Pursuit of an experimental trial would pose ethical issues in assignment of need based aid, and the resources needed to complete this kind of study are typically out of reach for most researchers. Further, students' participation in aid programs is not random, participants choose treatment based on observed or unobserved characteristics resulting in self-selection bias (Light et al., 1990; Willis & Rosen, 1979). Self-selection bias can lead to endogeneity, which can create large standard errors and biased coefficients (Light et al., 1990). Student choice is often the mechanism that defines treatment group and is a reason prior aid studies have used offered aid as opposed to accepted or disbursed aid, as the latter are confounded by other variables typically important in the study of treatment effects (DesJardins, 2003; DesJardins et al., 2002). DesJardins and McCall (2010) recommend avoiding variables that may be endogenous to the outcome variable of time to degree. This was impractical in the study of R2T4 as it affects disbursed aid, a financial state resulting from student choice that is influenced by endogenous variables. Thus, endogeneity is unavoidable in the assessment of average treatment effects of R2T4 on our outcome variable of interest and must be addressed.

To address endogeneity, past researchers have used regression discontinuity (RD) to more accurately determine causal effects of financial aid on student success (Chen & Zerquera, 2011; Darolia, 2013; Rubin, 2011). This approach allows for causal descriptions of how a policy may influence student outcomes by assigning two groups, one a control and one a treatment group (Bellman & Cooke, 1963; Murnane & Willett, 2011; Shadish et al., 2002). RD requires that the cause precede the effect (that is, there cannot be potential for reverse causation) and that there be an exogenous cut off prescribing treatment that is conditionally random (Murnane & Willett, 2011). This latter assumption is difficult to confirm in a study of the federal aid withdrawal policy (R2T4),

as students may have characteristics that influence chances of stopping out. It is also difficult to confirm if students are completely unaware of the treatment cutoff date, as they consult with academic advisors who are aware of federal policy and the potential billing of aid if students withdraw prior to the 60% point of the term. While academic advisors are instructed not to advise students based on aid policy (as it would violate the intent of the law), it is difficult to determine if every student who withdraws from this institution does so without understanding the cutoff dates which would violate the assumption of exogeneity.

Propensity analysis has also been used to correct for self-selection bias by creating a probability of treatment using observed covariates in the study (Chen & Hossler, 2017; Herzog, 2017; Rosenbaum & Rubin, 1983). This accounts for probability of self-selection by creating a coarse balancing score for each individual using the observed covariates, reducing the confounding effects of these variables on the outcome and providing a more precise estimate of the effect of treatment (Austin, 2011; Rosenbaum & Rubin, 1983). Once the propensity score is determined for each subject, researchers have utilized matching, subclassification (stratification), inverse probability of treatment weighting, and covariate adjustment to remove the effects of confounding and to more acutely measure treatment effects on an outcome (Austin, 2011; Rosenbaum & Rubin, 1983; Rosenbaum, 1987). However, propensity may bias results further if there is not large overlap between control and treatment groups, and as result of inclusion of variables which informed the score itself (correlation) (Hade & Lu, 2013). While propensity methods could inform which factors may influence withdrawal, they are not equipped to measure effects on time to degree and thus cannot effectively answer the research questions in this study.

Omitted Variable Bias

This type of bias translates to one or more unobserved variables being correlated with both the dependent and one or more independent variables in a study, which can also over or under estimate effect of treatment (Cellini, 2008; Light et al., 1990). Regression discontinuity, described above, is one method used to address this bias. Additionally, researchers have used instrumental variables to carve out some of the variation due to an unobserved omitted variable by using a dummy instrument (Cellini, 2008; Murnane & Willett, 2011). However, selection of an appropriate and efficient instrument cannot be directly tested and continues to be a criticism of this approach (Cellini, 2008; Chen & Zerquera, 2011). Others, like Heller (1999), have used fixed effects to address omitted variable bias with time series financial aid data, where a unit of analysis (e.g. student) is compared to itself and must have variation in the outcome of interest over time. However, this method only includes observations that experienced a net change, which reduces sample size and restricts the number of variables which can be included in the model (Cellini, 2008). Removal of observations and restrictions on numbers of variables can bias results. This is a concern for this study because students without a net difference in amount of time enrolled to degree, may still experience a delay in total elapsed time which has longer term economic implications. Thorough review of past theoretical and conceptual frameworks continue to be a way in which to reduce omitted variable bias.

Nested Units of Analysis

Another complication in the study of aid policy are nested units of analysis, students nested within institutions, nested within states, nested under the federal government. Each layer has political and environmental factors which influence types and amounts of aid students receive, making it difficult to tease out influence of one

federal aid policy on students nationally. Studies which use national survey data deal with this complication by using hierarchical generalized linear modeling (HGLM) as was the case in Chen and St. John's study (2011) on state aid policy and student persistence. However, the temporal nature of financial aid is omitted losing valuable information on the influence of aid over time as it fluctuates over time (Chen, 2008). This is due in part to the limitations of the national survey data used, which only measures gift aid in year one and does not track students who stopped out of their initial institution of attendance. Chen & St. John (2011) among others comment on the commonplace action for students to enroll at other institutions outside of their first college. Focus on students at one institution and ability to track them across institutions produces better understanding of the nuances of R2T4 by including student mobility and controlling heterogeneous effects of context at each political and social tier. Additionally, R2T4 and resulting bills of aid are not tracked or surveyed at a national level nor are the vast variation in institutional refund policies and environments. This could mask treatment effects, so focusing on one institution assists in resolving a number of issues caused by nested units allowing a deeper dive on the effects of federal aid policy on student time to degree.

Temporal Nature of Financial Aid

Past research explored the effects of aid policy on persistence from a start to end point, but assess a dichotomous outcome and do not address duration or time it takes for students to complete (Li, 2008). Failing to account for time means masking variation over time (Allison, 2014), translating to increased costs via additional college expenses and future earning potential. Those studies which have evaluated financial aid in relation to time to degree use event history methods; however, they tend to include aggregated aid, often citing limitations in data sources to identify the effects of different types and

amounts of aid. For example, national and state surveys do not contain robust repeated measures, including lack of repeated measures of gift aid (Chen & Hossler, 2017; Gross et al, 2013). A large advantage of the current study is the use of an institutional data set with more detailed observations of time and types and amounts of aid across the observation window. Evaluating the net effects of the R2T4 policy requires more minute observations of aid changes and a model which can accommodate the transitory nature of student enrollment.

Given the numerous methodological challenges faced by researchers in the past, I understood that regardless of which statistical methods I used, evaluating the influence of R2T4 while recognizing the many aspects of student behavior would be difficult to achieve without some level of bias. Thus, I made decisions on research design with three principal considerations: 1) evaluating the influence of an aid policy which changes aid over time ultimately requires a model and data which can be assessed over more granular periods of time, 2) students who withdraw from school are more likely to experience subsequent stopouts, so I considered fixed effects based on the number of withdrawal episodes to address different group frailties, and 3) the R2T4 policy affects disbursed aid only by percentage, so to understand the influence of a financial aid bill we need to understand the aid disbursed. The rationale for this framework and methodological design are described in the following section in consideration of these principles.

Framework of the Study

Addressing the challenges of past financial aid research begins with leveraging a framework which considers the varied spheres of influence on student enrollment behavior. Chen's (2008) heterogeneous framework centers the diverse characteristics of the student body, accounting for sociological, psychological, organizational,

interactionalist, and economic determinants of student enrollment patterns (Braxton & Hirschy, 2005; Chen, 2008; Tinto, 1992). Chen (2008) argues that the economic diversity of the student population requires researchers to explore the variation of aid effects on dropout risks across subgroups as opposed to netting average effects across a population. Recognizing there is variation in response to aid and aid changes across students, my analysis controlled for student background, pre-college, financial aid, and college performance variables which other researchers have found to explain some of the variance in student decisions to persist (Gross et al., 2013; Stewart et al., 2015). Chen's (2008) heterogeneous approach provides a holistic way of addressing the problem and research questions, controlling for contextual factors that may influence time to degree. This approach also addresses how a treatment may evoke different responses from different groups of students, which substantiates evaluation of student time to degree across the range of incomes present in the sample.

Methodological Approach

The intent of this study was to determine whether a student who withdraws from the university graduates, and if so, when this occurs and how this timeline is influenced by the federal aid withdrawal policy. The best method was one that can measure and control for variables that change over time and can compare differences across unknown and varying points of time (DesJardins & McCall, 2010). The following section describes event history methods, which were used to answer this study's research questions about when and whether an event occurs (Singer & Willett, 2003). The advantage of event history methods over traditional regression is the ability to observe how covariates influence an event over time as opposed to identifying levels of variance at one point of observation (Allison, 2014; Singer & Willett, 2003).

Event History Analysis

Before addressing the analytical approach to the research questions, it is important to understand the foundational concepts of event history methods, including censoring, the survivor function, the hazard, and correlated and dependent events. The following section lays the foundation for understanding the logic and strategy of this study in addressing how time to degree is influenced by federal policy.

Censoring

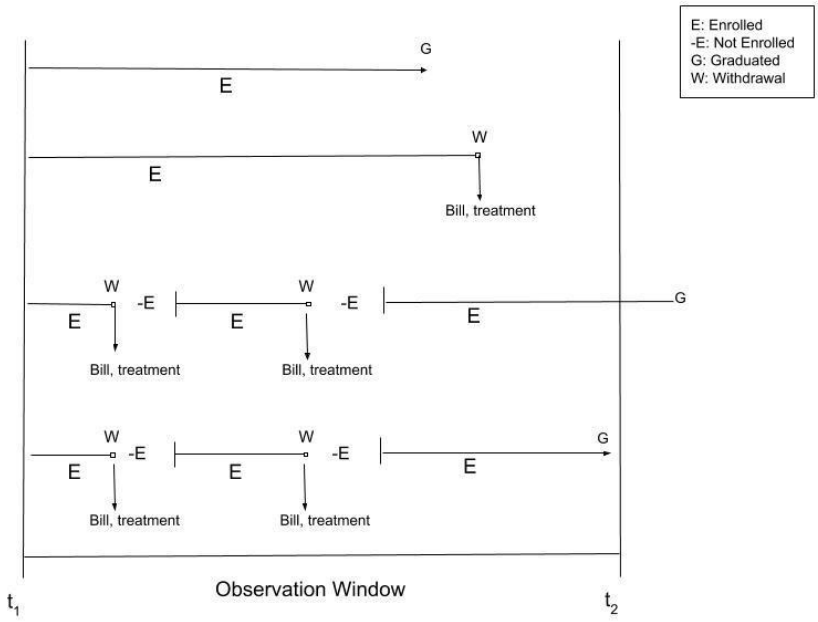
There are two types of censoring, left and right censoring, which reference units with incomplete information on the event of interest. Traditional regression models typically omit these cases or impute the information which can lead to biased estimates (Allison, 2014; DesJardins, 2003). Left censoring refers to a participant experiencing an event of unknown start time prior to the beginning of the period of observation (Allison, 2014). An example would be if a student enrolled in another college prior to the observation window of the study and were subsequently included. Left censoring was not a concern in this study due to the parameters of the observed sample, which only includes first-time freshmen with specific admit terms at a designated institution. First-time freshmen are defined as students with no prior college credits and whose first enrollment in a higher education institution is at Golden Mountain University (GMU).

The second type of censoring is referred to as right censoring, where the unit of observation does not experience the event of interest, in this case degree completion, within the observation period but may do so beyond frame. In this study a student can be right censored if they experience either withdrawal (departure) or remain enrolled at the end of observation and did not complete their degree. This latter instance is referred to as fixed censored. The student may complete beyond the observation period and so their

censoring is fixed as result of the limits of the study (Allison, 2014). Figure 3.1 illustrates examples of right and fixed censoring that may be found in this study, among others.

Figure 3.1

An example of student enrollment behavior and right and fixed censoring



Survivor Function

The survivor function refers to the probability that a unit will survive beyond a specific time *t* (Box-Steffensmeier & Jones, 2004). In this study, as students complete their degree or withdraw, the proportion of students who are "surviving," or who remain enrolled, decreases over time. The assumption of event history models is that all units will fail (experience a terminal event and fail to survive within the data set) if the observation period were infinite (Box-Steffensmeier & Jones, 2004), thus the survivor function only decreases over time. This function is used in relation to those who complete their degree (fail) in each time period to determine students' risk of failure (or the conditional probability they will experience this event.

Hazard

The hazard rate, or hazard, is the dependent variable of interest in this methodology. It is the conditional probability an individual will fail, or experience an event at time *t,* in discrete time, if they have not already experienced the event of interest by that time (Allison, 2014). It is a conditional probability because it uses information from past observation periods to determine the risk of event occurrence in the current time period (Box-Steffensmeier & Jones, 2004). In other words, hazard probabilities are calculated for each time period by taking the proportion of students who graduate of those who remain enrolled in that period (Willett & Singer, 1991). These probabilities are then sequenced across time creating the hazard function, which relays the conditional probability of graduation in any given time period.

A strength of event history methods is inclusion of both the successful and censored groups, providing a more comprehensive assessment of influence. Traditional regression models do not account for censored units; they are typically ignored (Mills, 2011). Thus, traditional regression models are not sufficient for this study. I am concerned with completers as much as those who do not complete when evaluating how aid policy influences these outcomes. Further, event history models assess risk at every time period, not just beginning and end, as is typical of other studies. Financial aid and enrollment behavior are longitudinal in nature. Event history methods can include repeated measurements, which can detect how policies may have differential effects across time and across units.

Research Questions

With semi-parametric event history methods, I evaluated the direct and indirect effect of the Return to Title IV (R2T4) policy on time to degree attainment for the 2006

through 2011 first-time, full-time freshmen cohorts of FAFSA applicants at a four-year research intensive large public university. Event history methods use time to an event as an outcome and can control for time dependent and correlated events. Controlling for student background, pre-college preparation, financial aid received, and college performance variables, the following questions guided this inquiry:

1. How do amounts billed students as result of the R2T4 policy vary across incomes and across time?
2. For those who withdraw, how does the amount of billed aid as result of R2T4 affect time to degree and degree completion at Golden Mountain University?
3. Of those students who withdraw from Golden Mountain University, how does the amount of billed aid influence their time to degree and degree completion at any institution?

Analytical Approach

Descriptive statistics of the data characterized the relationship between student background, pre-college preparation, financial aid received, college performance and degree attainment. This included a baseline analysis of the rate at which students graduate and how this varies across incomes and by institution where the student earns their degree. Understanding the context of time to and location of degree is important to discerning whether differences exist among the population which can be attributed to the R2T4 policy.

Descriptives also extend to the first research question and provided a baseline on how the amount of billed aid does or does not differ across income levels and across time. This set the stage for determining if differences which may exist can be linked as

effects of the R2T4 policy. Statistics also include average and median time in days to degree attainment.

Research Questions Two and Three Analytical Model

The second question drives at the core inquiry of whether there is a causal relationship between the R2T4 policy and time to degree. My first step was to compose a person-period data set, limited to students who experienced at least one withdrawal from the institution during the observation window. Each student from the sample had a row for each time period, along with values of all time-variant and time-invariant variables. The timing of the bill modified the duration of the observation, which created a simultaneous relationship with time. To address this Box-Steffensmeier & Jones (2014) recommend lagging the variable of interest, so I created a binary lagged variable for treatment.

My second step was to run multicollinearity tests by regressing stop time on all model covariates. The third step was to conduct event history analysis (EHA) models for terminal event of degree as described earlier in this section. Specifically, I used the semiparametric Cox proportional hazards model to evaluate the direct influence on degree:

$$h_i(t) = h_0(t) \exp(\beta' x), \tag{3.2}$$

where $\beta' x$ represents the covariates and interactions and where $h_0(t)$ represents the baseline hazard, though this is not directly estimated in the model (Cox, 1972; Box-Steffensmeier & Jones 2014).

Finally, I included interactions to determine if there were disparate effects of the federal aid policy across family incomes and across time. I ran statistical tests to determine fit and proportionality with time. This allowed me to be confident in my results

and how my covariates may or may not be proportional over income levels and over time. Sensitivity analyses revealed large shifts in coefficients for the treatment under different extreme scenarios, a) all students without degree are coded with degree at final exit time, and b) all students without degree are coded with degree immediately upon censor. These tests revealed I cannot discount the presence of informative censoring, though I would argue that if this scenario exists, it is expected given the covariates are related to the action of withdrawal. However, it does mean that declining hazards should be assessed with caution (Allison, 2014).

Two Distinct Models on Degree Completion

A weakness of prior financial aid studies that focused on one institution was lack of information about student mobility, including lack of data on students' enrollment and receipt of aid at other institutions. A unique attribute of this study was the availability of student record data across time and across institutions of attendance via NSLDS and NSC databases. However, financial aid types and amounts are limited to federal grant and loan received. Thus, two distinct models were used to evaluate the effect of R2T4 federal aid policy. The first included enrollment and financial aid data at Golden Mountain University. It did not account for enrollment or aid received at other institutions. It merely considered periods of no enrollment as censored periods in the conditional probability of degree completion and time to degree. The financial aid data information was robust in this model including federal, private, and institutional aid types and amounts by term.

The second model removed state and institutional aid variables, academic information, and academic progress as information on these variables at other institutions is unknown. However, the second model accounted for federal grant and student loans

received at other institutions, as well as including periods of enrollment at those institutions. The aim of this model was to understand how R2T4 affects time to degree if we account for student mobility and federal aid received.

Data Sources and Model Set Up

I used data from several sources for this analysis, including the National Student Loan Data System (NSLDS), National Student Clearinghouse (NSC), and Golden Mountain University (GMU). The institution provided biographical, enrollment, admissions, and financial aid data disbursed by term and by student at that campus. A time series person period data set was created by combining the institutional data with NSLDS information on any federal aid disbursed to these students at other institutions, and with enrollment and graduation data from NSC.

Golden Mountain University

The following offers a general description of the institution to provide context and maintain confidentiality of the data source. The figures and facts reported are greatly rounded and in some areas omitted to help avoid identification of the institution. The principal investigator and co-principal investigator vetted the data sources and can affirm these details are authentic. Golden Mountain University, a pseudonym, is a large-sized public research institution, serving approximately 20,000 undergraduate students who are pursuing bachelor's degrees at last recording for the 2018-19 academic year. The 6-year graduation rate for the 2009-10 cohort was a few points shy of 80%, and 8-year graduation rate averaging 80% (U.S. Department of Education, National Center for Education Statistics, 2018). The undergraduate body is comprised of just over 30% of students who identify as white and nearly 30% of students who identify as Latinx. These two groups have shifted considerably since fall 2008 where the student body was about

50% white and just over 15% Latinx. This exists in part due to enrollment growth, as well as a decline in the population of White students who have enrolled. There has been a marginal increase in students of all other ethnic groups from 2008 to 2018. State funding declined after the economic recession of 2008, sparking a shift in the campus' recruitment strategies which may have changed the ethnic makeup of its student body. Additionally, the campus shifted to holistic review in the admissions process, which accounts for a student's whole experience as opposed to relying entirely on standardized tests and high school GPA.

This institutional data set provided access to students whose enrollment at the institution indicates intent to earn a four-year degree as this is the only degree type offered for entering freshmen. While GMU is not representative of all similarly classified colleges, it provides a large and accessible data set on first-time freshmen entrants evaluated against a standard admissions criteria. The level of detail is a significant advantage of this data set over others used in past research. Financial aid data is fairly limited due to strict privacy laws which restrict its availability for research purposes (U.S. Department of Education, Privacy Technical Assistance Center, 2017). This is a reason past studies that used national surveys could only account for some types of aid at year one and not across time. Conversely, persistence and departure studies that utilized institutional data with greater financial aid detail were limited in tracking students across institutions. Thus, the data set for this study addressed critical weaknesses in past financial aid and persistence research.

National Student Loan Data System (NSLDS)

The NSLDS database tracks federal aid dollars disbursed to a student by amount, loan period, and institution. This provided information on federal aid received at other

universities outside of GMU which adds aid information for students who began at GMU, but persisted and/or graduated elsewhere. This information served the second model which examined how aid policy influenced time to degree for students who complete their degree at any institution.

National Student Clearinghouse (NSC)

The NSC tracks students' enrollment by institution attended, including periods of enrollment, percent time enrolled (e.g. full-time, half time, etc.), and conferral date. Like the NSLDS data, this adds to our completion information for students who began at Golden Mountain University but completed their degree elsewhere. The data from these sources provided repeated measures of enrollment and disbursed aid for each student, necessary for understanding the influence of the federal aid withdrawal policy over time. Comparison of degree information from Golden Mountain University and NSC revealed some misalignment and inconsistencies. This is a limitation which is discussed in chapter five.

Sample

My sample included 591 first-time full-time freshmen who entered Golden Mountain University in the fall term of the 2006 through 2011 academic years, applied for the FAFSA (Free Application for Federal Student Aid), and had official expected family contributions (EFCs), the barometer used to determine financial aid eligibility, and had at least one withdrawal event. The multiple cohort selection years allowed for a longitudinal study and increased sample size by including multiple entering classes and increasing the number of observations, but still presented a concern about power of the model. Additional information about power and model fit are included in Appendix K: **Data Decisions** Several studies have evaluated persistence within the six year period;

however, given the mean graduation rate for first-time entrants at 4-year public colleges hovers around 60% for the national population in that time frame (U.S. Department of Education, National Center for Education Statistics, 2018a), withdrawal from an institution is likely to extend a student's time to degree beyond six years (Gross & Berry, 2015). Thus, these cohorts were selected based on the time of entry to the bachelor's degree career level being more than six years in the past from the study start date.

Student mobility is extremely complex, given the various social, economic, cultural, and institutional structures that contribute to and detract from this phenomenon (Goldrick-Rab, et al., 2016; Gross & Zerquera, 2016). This was the reason to collect data from the National Student Clearinghouse and expand information on whether students completed, and if this was done at their initial university or another institution. I had repeated observations over the time of data collection, containing both time variant and time invariant variables, a series of data points necessary to conduct a longitudinal study (personal communication, P. Allison, June 15, 2018). Most importantly, I collected data on withdrawal, duration of enrollment periods, and conferral of degree.

Variable Selection

An assumption of this study was that student degree attainment is a campus-based phenomenon, thus observation of the influence of a policy on time to degree attainment must be based at the institutional level using variables available for most students. Variable selection was informed by Chen's (2008) longitudinal research approach to the study of financial aid and student departure. This included recommendations to include variables associated with student background, pre-college preparation, college experience, organizational effects, financial factors and college experience. Educational aspiration is not included in the model as enrollment at Golden Mountain University, a 4-

year degree granting institution, assumes intent to earn a bachelor's degree. It also does not include organizational effects for the first model as the study is focused on one public institution and the most studied characteristic is public versus private (Chen, 2008). These variables were also informed by recommendations of Willett et al. (1998) on development of longitudinal studies, primarily inclusion of interactions with independent variables and with time. The initial list of covariates were trimmed and transformed after statistical tests were used to determine model fit. Additional details on these data decisions are explained in Appendix K**: Data Decisions**.

Dependent Variables

The outcome variable of time to event defines whether and when students graduate with their bachelor's degree. As was mentioned earlier in discussion on censoring, students who remained enrolled at the end of the observation period are considered right censored. *Degree* was coded 1 for degree completion or 0 if no degree.

Key Independent Variable

Students are billed one total sum amount based on the types of aid they received in the term and based on the percent they completed of the term. However, to address its infrequent occurrence (<6% of observations) and the problem of simultaneity as described earlier in the analytical approach, I created a lagged binary variable of *b_lag* and coded it 1 if billed in prior term and 0 otherwise to measure influence of bill on degree attainment. A categorical variable of *anybill* was also created to identify students who ever experienced a bill.

Interactions

The key independent variable, *b_lag,* was interacted with time and total income, to determine the change in its hazard on graduation over time and across incomes. The

interaction with time resulted in no measure likely give the Cox model output being a measure of time on terminal event.

Covariates

In addition to Chen's (2008) suggested variables in studies on student enrollment behavior, covariates included in Table 1 were also informed by my knowledge as a financial aid administrator and on what past research has found to be influential on student enrollment and completion behavior. The table includes notation on which variables are included in which of the two models in this study, one focused on Golden Mountain University enrollment and completion (Model A), and the second on completion at any Title IV postsecondary institution (Model B). Appendix J holds the original variables captured for this study, before transformation and aggregation due to statistical tests which showed multicollinearity and high correlation.

Student background variables are derived from the initial processed FAFSA in the student's freshmen year and from the student information system and are treated as time-independent, except for dependency status which may change over time. This set of variables are all categorical and are included to measure differences in graduation based on self-reported gender, belonging to a traditionally underrepresented ethnicity, and parent's education. Pre-college preparation, operationalized as cumulative high school GPA on a 4.0 scale taken from the admissions application, is a continuous variable treated as time-independent and was included to control for academic preparedness prior to entering college.

College experience variables were included to measure longitudinal differences in academic performance. They included college GPA on a 4.0 scale which is time variant as it changes by term, academic credits earned by term which are also time variant, and

cohort year based on the student's first term of enrollment which is time-independent. High correlation between GPA, Credits and treatment necessitated dropping Credits and transforming College Term GPA to cumulative GPA.

Financial factors included total family income and assets from the FAFSA measured each year and financial aid received by term and by type. It also included residence for tuition purposes, housing status, and dependency status measured annually based on the federal definition on the FAFSA. These categorical variables determine a student's types and amounts of aid offered and their budgeted cost of attendance. Organizational effects included organizational type in the second model to account for how different settings and program offerings may influence degree attainment. Time in college was used in conjunction with degree as outcome. As students who withdraw are more likely to experience subsequent spells of non-enrollment (DesJardins & McCall, 2010), I considered fixed effects based on the number of withdrawal events by student to address this omitted variable bias (Heller, 1999). Finally, interaction effects were included to evaluate heterogeneous effects of billed aid across incomes and across time.

Table 1
Description of Study Variables

Table 1 Description of Study Variables

Variables	Definition	Model A	Model B	Reference Group	Variable Classification
Lagged Bill	Instance of bill in prior observation period at Golden Mountain University as result of Return to Title IV policy	X	X	-	Time-varying
Student background					
Female	Gender reported on FAFSA from freshmen year	X	X	Male	Time-independent
Underrepresented ethnicity	Students' primary ethnicity is not White or Asian as coded in the student information system	X	X	White/Asian	Time-independent
Parent education	The highest level of education recorded for parent(s) on the student's FAFSA from freshmen year	X	X	Jr. High	Time-independent
Pre-college preparation					
Cumulative HS GPA	High school GPA measured on 4.0 scale as reported on student's admissions application	X	X	-	Time-independent
College experience					
Cumulative College GPA	Mean centered College GPA x Credits	X		-	Time-varying
Percent Time Enrolled	Percent time enrolled by term		X	Full-Time	
Financial Factors					
Total family income	Total income as measured on FAFSA by aid year in dollars	X	X	-	Time-varying
Income Group	Median total income from FAFSA(s) categorized using CA Dept of Housing and Development tool		X	Moderate/High	Time-independent
Total assets	Sum of cash, savings, and investment net worth as reported annually on the FAFSA	X		-	Time-varying

Table 1 Continued

Variables	Definition/Coding	Model A	Model B	Reference Group	Variable Classification
Independent	Output as determined by student response to statutorily defined dependency questions on FAFSA	X		Dependent	Time-varying
Gift Aid	Sum of federal, university, and other non-state gift aid or waivers in dollars received by the student during each enrollment term, including Pell Grant, Supplemental Education Opportunity Grant, Vet Benefits, and Other Fed. Grant	X		-	Time-varying
Pell Grant	Sum of Pell grant in dollars received by student during each enrolled term at any institution		X	-	Time-varying
Student Loan	Sum of federal subsidized, unsubsidized, Perkins, and private loan (Model A), by term, in dollars	X	X	-	Time-varying
Student employment	Student earnings reported on the future year FAFSA received by the student, in dollars	X		-	Time-varying
Parent loan	Sum of federal parent (PLUS) Stafford loans received to the student's billing account during each enrollment term, in dollars	X		-	Time-varying
Residency	Residence for tuition purposes will be coded from student info. system	X		Resident	Time-varying
Housing status	Student's housing status will be coded by aid year based on the student budget	X		On-campus	Time-varying

Table 1 Continued

Variables	Definition/Coding	Model A	Model B	Reference Group	Variable Classification
Organizational Effect					
Organization type	Institution type will be coded using National Student Clearinghouse definitions.		X	4-year public	Time-varying
Interaction Effects					
Lagged Bill x Income	Total income will be interacted with instance of bill at Golden Mountain University	X	X	-	Time-varying
Lagged Bill x Time	Time will be interacted with instance of bill at Golden Mountain University	X	X	-	Time-varying

Limitations

Findings from this study may not be generalizable to the larger population of college students due to limits of use of one sample from one institution. Tracking multiple groups of students from different institutions had associated costs, but more importantly, institutions do not have uniform refunding policies, or social and political contexts. Thus, studies on aid policy and influences on time to degree may be more relevant if effects can be assessed at more detailed levels like institution or institution type. This study promises to be empirically and conceptually relevant to the financial aid policy research literature in a unique way despite this limitation.

The rationale of aid programs was to create equity and movement between economic (income) classes. This makes income the most salient independent variable by which to evaluate how the policy may inadvertently reproduce social and economic inequity. Still, race and ethnicity were included to quantify the effect of belonging to an underrepresented group on time to degree; past research has found students respond to financial aid differently by race and ethnicity (Chen, 2008; Hu & St. John, 2001). Initial exploration of the available data showed an insufficient number of observations in each racial/ethnic subgroup to provide enough statistical power for subgroup breakout analyses given the number of covariates. Students who identified as white or Asian were coded as the reference group as these groups have been found to have similar degree outcomes (Shapiro et al.), and all other racial and ethnic categories were coded as underrepresented. This limits our understanding of nuances between underrepresented groups in relation to application of R2T4, but does not sacrifice the importance of race/ethnicity to the analysis and context.

Unlike other studies on financial aid, this project focuses on original disbursed aid prior to student departure, given the federal aid withdrawal policy reduces aid received. This introduced an added limitation to this research as self-selection may bias the findings (Allison, 2014; Singer & Willett, 2003). Students must actively accept each type of aid on their offer, decisions influenced by other social, cultural factors, some of which are represented by other covariates in the model. However, self-selection bias is largely unavoidable in retrospective studies and difficult to remove completely (DesJardins, 2003). While self-selection bias was a concern, the primary focus of the study was to understand the effect of R2T4 on time to degree, a policy which can only be applied to students who choose to withdraw from the university and which can only apply on disbursed financial aid. Thus, financial aid variables are used for the purposes of controlling for their effect on degree, but their individual affect is not at the core of the research problem.

Using Chen's (2008) heterogeneous approach requires a wide breadth of variables in consideration of the varied social, economic, and organizational structures that guide concept of student time to degree. Given the number of variables, it was important to test for multicollinearity to avoid skewing errors and coefficients in the model (Chen, 2008). Thus, I conducted correlation tests on the covariates. Multicollinearity can be remedied via a number of data methods, dependent upon the type of variables, their relationships, and weighing the importance of those regressors in the model (Singer & Willett, 2003). While a robust review of methodologies and theoretical and conceptual frameworks was conducted to include all pertinent variables uncovered in past research, there remains the possibility of unobserved heterogeneity, such as social and academic integration. It is difficult to test if this variance is correlated with the observed variables in the study.

Decisions on the type and number of covariates was informed by evidence from past persistence and attainment research, as well as my experience as a financial aid administrator and an understanding of how to operationalize the R2T4 policy in an event history model. Additional detail on refinement of covariates in the model are detailed in Appendix K**: Data Decisions**.

CHAPTER 4: RESULTS

This chapter reports findings and answers to the research questions of this study using the analytical approach detailed in chapter three. First, descriptive statistics are given to provide an understanding of the study population and sample in terms of student background characteristics, pre-college and college experience, time in college, and degree outcomes. This includes presenting statistics over time for variables which vary over time, particularly the treatment of amount of billed aid and degree attainment, as well as information about where the sample completes their bachelor's degree. Second, nonparametric analyses are detailed to provide an overview of the survival times (or continued enrollment with no degree) and cumulative hazard rates (or cumulative risk of degree) for the population versus sample, and for those billed aid versus those not billed aid in the sample. Hazard and risk are used synonymously and refer to the conditional probability that a student will experience degree completion by time *t*. Third, the results of the event history analysis models are presented, beginning with the baseline models with no interactions, followed by the final models with interactions and/or fixed effects.

Descriptive Statistics

The study population included 10,559 first-time freshmen students who entered Golden Mountain University (GMU) in one of the fall terms from 2006 through 2011. From this group, 591 students withdrew from at least one academic term from GMU during their tenure. In the sample, 259 students graduated from GMU, of which nine were attending other colleges when they conferred their degree (e.g. transferred credits to earn degree). Additionally, twenty one students earned their bachelors from a private four-year institution and sixty from other public institutions, or approximately 17% of the sample conferred degree at another university. One student from the sample did not have

a record with the National Student Clearinghouse and so the second model explores outcomes for 590 students. Degree attainment at other institutions and reverse transfer of credits to earn a GMU degree revealed the mobility of the sample.

The median graduation enrollment time for the sample at GMU was 4.94 years and average degree time was 4.16 years. The median enrollment time to degree when reviewing National Student Clearinghouse data was 6.72 years, and average degree time was 6.29 years. This large disparity indicates that students enrolled at other institutions during their careers at GMU. Additional enrollment time at other institutions equates to additional terms used towards a maximum aid time frame. The students' mobility also indicated these students were incurring additional expenses at other colleges aside from their enrollment at their initial institution. Most importantly, this disparity in tracked enrollment time indicated a lack of full information using the home institution dataset, which can greatly affect time estimates for degree outcomes. Robust data is important and lack thereof can contribute to omitted variable bias and unobserved heterogeneity which can result in misleading declined hazard estimates (DesJardins, 2003; Allison, 2014). The aforementioned methodological challenges do not pose the same issues for increasing hazards, which can safely be interpreted as truly increasing (Allison, 2014).

While we have an understanding of enrollment time to graduation for the sample, it is important to understand how this group compares to the population. This provides additional information on how the sample is similar or different to other students on measurable characteristics, information that can shed light on whether we should expect greater weight on these aspects in regards to differences in degree completion. The following two sections review non-aid and aid variables to provide this context. Tests of the differences in degree outcomes are mentioned later under Non-Parametric Analyses.

Descriptives of Non-Aid Variables

As detailed in chapter one and three, a withdrawal is defined as a student who petitions to leave the university during an academic term where they were enrolled in credits. The following section makes references to the population, indicating the cohort of Golden Mountain University students *excluding* those who experienced a withdrawal event, where references to sample refers to those who did experience a withdrawal event. There were similar proportions of students in the population and withdrawal sample who identified as an ethnicity other than Caucasian or Asian, 38 percent and 39 percent respectively (see Table 2). Females comprised a greater proportion of the population at 57 percent versus 51 percent of the withdrawal sample, exclusive. Both groups have similar distributions of parent education and high school GPA.

Table 2

Descriptive Statistics of the Sample and Population

	Min	Max	Sample Mean	Population Mean	SD
Female	0	1	.51	.57	-
Underrepresented Ethnicity	0	1	.39	.38	-
High School GPA	0	4	3.50	3.54	.33
Parent Education	0	3	1.79	1.80	-
N			591	9,968	

Note: Means are rounded to nearest hundredth. Standard deviation for high school GPA is the same for both groups

There were several non-aid time varying covariates in the dataset listed in Table 3 for odd years. The time snapshot encompasses observation from the start to the day preceding the end of the year. While students began enrollment in different years, the

groups were aligned in analysis using their origin time as time zero. Odd years were selected for display as the start time of year zero would not have practical results for comparison, and student attrition has been found to be most common by end of year one for traditional college students and high risk groups (Chen & DesJardins, 2008; Ishitani, 2006; Nora & Cabrera, 1996). Additionally, few students remained in the sample at years ten and eleven (less than ten) generating little mean output for the listed variables.

The data revealed the population had non-residents enrolled in slightly larger proportions exclusive of the sample over time, suggesting that nonresidents survived (were enrolled and did not graduate) in greater proportions and for longer time in the population; the sample showed that students who withdrew were predominately state residents. Significantly fewer students resided on campus at year three onward in both groups, though we see this trend reverse slightly in year seven. There were more instances of independent status in the withdrawal group than in the general population in year three through the end of the observation window. We see the proportion of independent status jump significantly in both groups at year seven as most students would be independent by age (24 or older) according to the FAFSA (Federal Student Aid, 2017).

Table 3

Means of Time-Varying Demo Variables at Odd Years - Sample (top) vs. Population (bottom)

	1	3	5	7	9
Residency	0.03	0	0	0.01	0
Housing	0.03	0.76	0.89	0.79	0.82
Independent	0.01	0.03	0.05	0.98	0.92
Total Income	75,326	74,665	77,301	12,965	15,787
Net Worth	48,162	54,250	53,703	6,383	7,555
College GPA	2.60	2.37	2.43	2.52	2.20
Credits	12.58	11.51	11.92	10.16	11.64
N	513	380	131	34	13

	1	3	5	7	9
Residency	0.03	0.01	0.01	0	0.04
Housing	0.03	0.73	0.86	0.87	0.83
Independent	0.01	0.02	0.04	0.83	0.87
Total Income	72,778	74,652	62,660	30,756	19,744
Net Worth	51,373	49,857	38,815	43,307	0
College GPA	3	3.06	2.99	3.01	2.42
Credits	14.25	14.46	13.98	17.42	15.96
N	9193	8150	277	58	17

Note: Dollar amounts rounded to nearest dollar. Less than 10 students present at year 10 and through end of observation.

By year five, the decline in total income was steep in the population; however, we do not see a similar trend in the sample. This suggests that students from higher family incomes in the population graduate or are censored by that time and that students who can continue to enroll are those of higher financial means in the sample. Related to

independent status, we see a significant decline in total income and net worth at year seven as the FAFSA evaluates only student financial information once they are qualified as independent. However, the average total income is 2.4 times larger in the population than in the sample at year seven, and net worth is nearly seven times as large. This suggests that students who experience withdrawal and survive until year seven have lower financial strength than students remaining in the general population. Tests of the equality of the survivor function also showed statistically significant differences between dependent and independent students, with the latter completing lower than expected number of degrees in the observation window.

Finally, the mean of college term GPA and term Credits increased from year one to year three in the general population, but declined in the same period for students who withdrew. This indicates students in the sample performed worse academically than their peers in the early part of their academic career. The inverse occurs after year three through year seven, where the mean GPA declined for the population (3.06 to 3.01) and improved modestly for the sample (2.37 to 2.52). Average credits improved from year three to five in the sample and declined at year seven. However, the population showed declines to year five but a jump by year seven. There are a small number of students remaining in the pool by year nine and GPA and credits earned are markedly lower for the sample and population through the end of the study. This suggests students who survive until year nine and beyond are more likely to underperform academically.

Descriptives of Aid Variables

Table 4 contains the mean aid amounts disbursed by term by year Golden Mountain University. The purpose of listing this information was to compare the sample to the population in terms of academic and aid behavior. Financial aid variables include

several forms of grant and loan. Student employment (Employment) is included in this table as it is a form of financial support a student uses to meet their costs. Employment refers to a student's work during the observed time period and may include federal work-study and non-work-study earnings. These amounts also reflect zero disbursement values and reduced disbursements due to enrollment changes and students not meeting eligibility criteria.

While federal, state, and university grant were lower for the sample in years one through five as compared to the population, this may be explained by fewer number of terms of high need students enrolled and/or enrollment changes which alter aid. The lower average credits as detailed in Table 3 supports the suggestion that the sample average grant amounts are lower due to enrollment changes. Subsidized loan usage is similar across groups across time, but unsubsidized loan usage is noticeably larger in the sample for year seven and nine. The sample received about 1.7 times more unsubsidized loan in year seven and 1.4 times more than the population in those same years.

Perhaps the largest disparity among the aid variables is in student employment where we see much larger earnings for students who are enrolled year seven in the population versus the sample, $11,851 to $5,766. Again, the population that survives through year nine have greater financial strength than the withdrawal group.

Table 4

Means of Aid Variables at Odd Years for Sample (top) vs. Population (bottom)

	1	3	5	7	9
Federal Grant	705	692	777	1,465	1,596
State Grant	1,123	1,637	827	0	935
University Grant	1,692	1,015	2,082	4,568	3,200
Other Gift	263	142	194	121	64
Sub Loan	689	973	970	990	1,066
Unsub Loan	360	585	655	1,047	1,038
Perkins Loan	163	8	2	0	0
Employment	1,473	2,108	3,589	5,766	7,628
PLUS Loan	1,023	801	504	0	0
Private Loan	94	118	90	0	0

	1	3	5	7	9
Federal Grant	768	746	1,026	1,454	1,247
State Grant	1,121	1,800	359	239	0
University Grant	1,748	1,072	3,250	3,554	4,272
Other Gift	268	165	205	450	0
Sub Loan	713	975	1,081	840	1,068
Unsub Loan	356	526	569	623	728
Perkins Loan	172	6	1	7	0
Employment	1,467	2,205	3,265	11,851	9,712
PLUS Loan	1,122	759	466	0	0
Private Loan	92	88	980	129	0

Note: Zero output indicate omission due to limited observations with positive amounts.

Dollar amounts rounded to nearest dollar.

Nonparametric Analyses

The prior descriptives give context for how the base variables measure for the sample exclusive of the population, including median and mean time to degree. The following section compares survival times and cumulative hazard rates for the population versus sample, as well as for those treated with R2T4 in the sample. Nonparametric analyses provide an overview of the survival times (or probability of continued enrollment with no degree) and cumulative hazard rates (or cumulative risk of degree) at each time period. Since time to degree was the outcome of interest in this study, an overview of survival and risk measures gave differences in probabilities for these observed times between groups. Observed differences in these probabilities and risks substantiated the use of event history models to explain the correlation between treatment and the time to degree.

Nonparametric analyses, including Kaplan-Meier survivor graphs, single decrement life table, and Nelson-Aalen cumulative hazard estimates were utilized to assess the differences in degree attainment between the population and sample. I list these population and sample estimates, followed by similar analyses focused on the sample for R2T4 bill, gender, and income. Ethnicity did not produce statistically significant differences in the sample, thus comparisons for this group of interest were excluded. Time is presented in years in this section, though analysis occurred in days and more precise estimates are provided where needed.

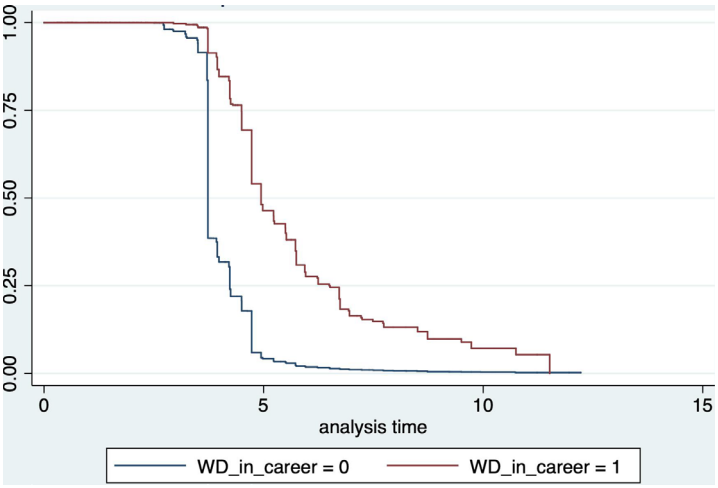
Population versus Withdrawal Sample

The Kaplan-Meier survivor graph includes a step function, where vertical drops or discontinuities indicate event times and proportion of the group experiencing an event. In Figure 4.1, the Kaplan-Meier estimates show a clear difference in the survivor function

for degree attainment between students who experienced and students who did not experience a withdrawal event. While the survivor function decreased with a terminal event of degree completion in this study, it did not decline with censored cases, or students who left Golden Mountain University during the observation window and did not return.

Figure 4.1

Survivor Function for Sample and Population



The proportion of students who survived until time *t* declined earlier for those who did not experience a withdrawal event, drastically so by year five. In contrast, students who experienced a formal withdrawal event survived in greater proportion and had a more gradual decline in the step function to degree attainment. This visual representation coincided with what is expected for departure from the university, an interruption to student progress. Failing to complete a term is tied to not earning credits required to make progress to degree, thus the survival estimates between the two groups is expected.

The decrement life-table (see Table 5) describes the survivor function for degree completion for the population and for the withdrawal sample. Here the survivor function

indicated a rough estimate of the probability of a student being enrolled without degree beyond the time interval. As was detailed in chapter three, censored cases only contribute to the survivor side of the function, meaning they adjust the starting total at each time period by which event occurrence is measured but do not affect the estimate otherwise. The start time up to but not including the end time of the duration are used in the estimate. For example, the probability of a student surviving (enrolling) beyond year four was .3181 for the population and .8532 for the sample, a substantial difference. As mentioned earlier, normative time to degree for a bachelor's level program is six years, but withdrawal from school is likely to extend completion time as students move across institutions (Gross & Berry, 2015). This suggested that evaluating outcomes across time longer than six years was important to determine full scope of degree attainment for students who withdraw.

The probability of being enrolled without degree in the population beyond year six was .0195 and in the sample was .2897, a likelihood nearly fifteen fold greater. The median time to degree for the withdrawal sample was 1805 days (4.94 years) and 1363 days (3.73 years) for the population. The average exit time was about 1354 days (4.16 years) in the sample, and 1298 days (3.55 years) in the population.

Table 5

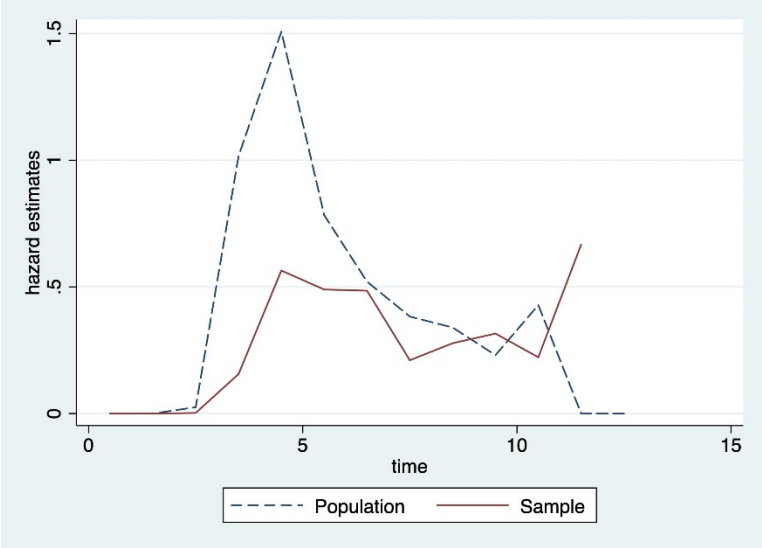
Single Decrement Life Table Population vs. Sample for GMU Degree

Time		Begin Total	Population Degree	Censored	S(t)	Begin Total	Sample Degree	Censored	S(t)
0	**1**	9968	0	775	1.0000	591	0	78	1.0000
1	**2**	9192	0	665	1.0000	513	0	83	1.0000
2	**3**	8527	208	171	0.9755	430	1	49	0.9975
3	**4**	8149	5486	140	0.3181	380	52	41	0.8532
4	**5**	2543	2245	14	0.0446	287	118	38	0.4776
5	**6**	277	200	9	0.0195	131	48	18	0.2897
6	**7**	111	68	4	0.0114	65	24	7	0.1766
7	**8**	58	24	10	0.0078	34	6	5	0.1438
8	**9**	31	14	5	0.0055	23	5	5	0.1081
9	**10**	18	6	1	0.0044	13	3	4	0.0786
10	**11**	10	4	4	0.0028	6	1	2	0.0629
11	**12**	2	1	1	0.0028	3	1	2	0.0315

Note: Time displayed in years, but estimates based on days in analysis.

Figure 4.2

Life Table Hazard for Sample and Population



The life table hazard (Fig. 4.2) reflects a split time risk for each time interval, using the number of events per duration divided by the number of students still alive at the start of the duration accounting for censored cases. This graph shows a stark contrast in risk of graduation between the population and sample, especially between years three and five. However, as time progresses the hazard declines substantially for the population and crosses the sample hazard near year eight, which indicates there may not be a statistical difference between the two groups after that time.

The sample was similar to the population in many respects, with any major differences occurring beyond year seven when the number of students remaining is small. The tail of the hazard (conditional probability of degree) is largely affected by the number of students remaining alive, thus the proportion surviving (remaining enrolled) is also of importance to understand the gravity of the hazard and why the difference in the two groups disappears at the higher end of time. To this point observed differences occurred with gender, dependency status, academic progress, and disbursed aid (though this item may be explained by changes in enrollment). This suggested that the differences we observe in Figure 4.2 could be attributed in part to these variables, a consideration as we transition to focus on the sample and R2T4 treatment.

Withdrawal Sample

As Table 5 showed, less than twenty-five students remained from the sample at the start of year eight and no students remained beyond year twelve. However, student enrollment history from the National Student Clearinghouse, showed 161 students remained at the start of year eight and there continued to be observations up to year fourteen. This indicated that students who withdrew from Golden Mountain University showed continued enrollment in other institutions beyond enrollment at Golden Mountain

University. A side-by-side comparison in Table 6 does not show severe differences in survival between those who experienced a bill at Golden Mountain University and those who did not. While initially concerning, grouping students into categories based on a temporal treatment can mask information which may explain differences in degree attainment.

Table 6

Single Decrement Life Table for Withdrawal Sample - Degree Any Institution

Time		Begin Total	No Bill Degree	Censored	S(t)	Begin Total	Billed Degree	Censored	S(t)
0	**1**	272	0	1	1.0000	318	0	1	1.0000
1	**2**	271	0	3	1.0000	317	1	5	0.9968
2	**3**	268	1	4	0.9962	311	1	9	0.9968
3	**4**	263	24	9	0.9037	302	25	11	0.9128
4	**5**	230	65	11	0.6421	266	54	23	0.7191
5	**6**	154	23	7	0.5440	189	39	11	0.5663
6	**7**	124	26	10	0.4251	139	11	16	0.5187
7	**8**	88	10	9	0.3742	112	13	17	0.4536
8	**9**	69	12	15	0.3012	82	10	21	0.3901
9	**10**	42	5	12	0.2594	51	8	12	0.3208
10	**11**	25	4	8	0.2100	31	3	10	0.2838
11	**12**	13	0	3	0.2100	18	3	7	0.2251
12	**13**	10	1	3	0.1853	8	1	2	0.1841
13	**14**	6	2	4	0.0926	2	0	2	0.1841

Note: Time displayed in years, but estimates based on days in analysis

Now that we have a picture of how the sample measures up against the population and of the survival of the sample grouped by experience of a bill, the following reports the cumulative hazard (cumulative conditional risk/probability of degree attainment) by

gender, income, dependency status, and bill group. Cumulative hazards for independent status and exposure to a bill were reported with data at Golden Mountain University only as these variables are not tracked across institutions. Though outcomes of gender and dependency were not at the core of this study, important differences are noted in this section as they proved critical predictors in all models for the sample and as they are aspects present in persistence and completion literature. Test statistics using equality of the survivor functions proved significant in degree attainment among each of these demographics, as well as by income group. As reported earlier in this section, ethnicity did not produce statistically significant differences so was not reported in this section.

Table 7 shows the degree and no degree count at Golden Mountain University by whether the student experienced a R2T4 bill at Golden Mountain University. Students who did not experience a bill showed slightly more degree incidents than no degree. Students who experienced a financial aid bill showed less degree completions at Golden Mountain University. Forty-nine of the 115 degrees shown of students who had a R2T4 bill were from moderate/high income families.

Table 7

Degree and Billed Aid of Sample at Golden Mountain University

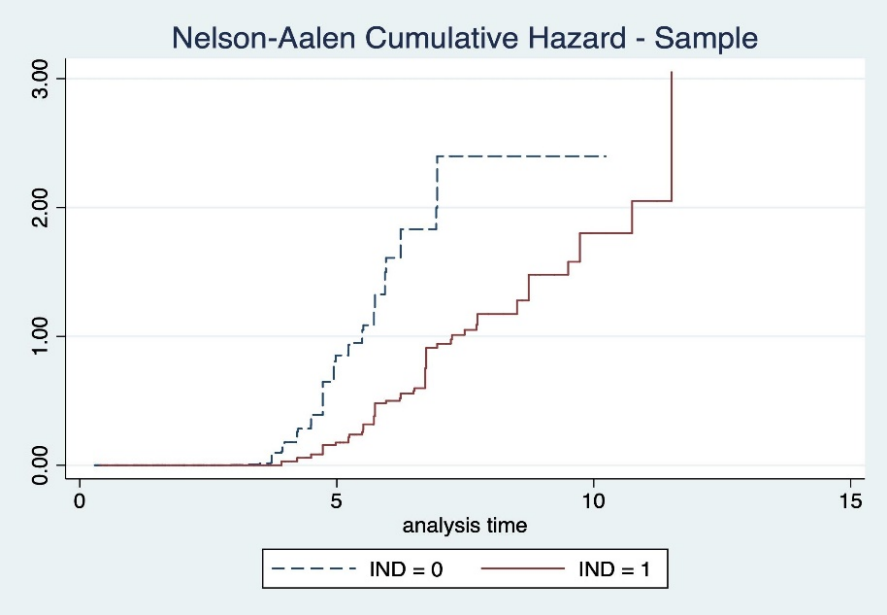
R2T4 Treatment	**Degree**	**No Degree**	**Total**
Billed During Career	115	205	319
Not Billed During Career	144	127	271
Total	259	332	591

The second model used National Student Clearinghouse data for the sample to track degree and enrollment information. It revealed 341 students earned their bachelors equivalent degree. A majority completed through Golden Mountain University, 60 from other public universities, and 21 from private universities. Interestingly, thirty-one students attended another institution in their final enrollment term in which they earned a degree from Golden Mountain University. Twenty-five degrees were earned by students of moderate/high income, compared to 27 earned by all other income groups combined. The following analyses explored the significance of these differences.

The Nelson-Aalen cumulative hazard graphs that follow are the visual output of a step hazard function of the aggregated hazards at each time period (Singer & Willett, 2003). This estimator sums up interval specific hazards to compute the total amount of accumulated risk that student *i* had from their origin time to present time *j* in the study. The slope of the hazard is a rough estimate of the rate of increase in risk at each time, and the vertical distance between two steps is the proportion of students who experience degree attainment of those who were in observation at the start of the time period.

Figure 4.3

Nelson-Aalen Cumulative Hazard - Independent Status



Dependent students (see Figure 4.3) had a steep slope in the cumulative hazard, indicating these students are exposed to greater risk than independent students at earlier times. Students categorized as independent have a more gradual increase in cumulative hazard of graduation over time than dependent students. This exposure to gradual increase of risk translates to a lower graduation rates and longer enrollment times than dependent students. This supports observations noted earlier of dependency status as one of the key differences compared to the population, and how this characteristic may contribute to differences in time to degree. However, the rate of increase is non-monotonic, meaning the difference in risk does not appear proportional across time. Independent students experience a large jump, along with dependent students at around year six. They show another large peak at year twelve, though the number remaining at risk is small.

Students who identified as female were exposed to greater risk of degree at earlier times than those of other gender. However, Figures 4.4.1 and 4.4.2 show the rate of increase appears relatively monotonic across both groups across time until year nine at Golden Mountain University when the two diverge, and at year ten when reviewing completion at any four-year institution. Again, low numbers remaining in the risk set may skew the tail of the hazard. A look at survival using both dependency and gender at Golden Mountain University (see Appendix A) showed significant differences between dependent students who identified as female and those who did not identify as female. The difference in survival is less stark by gender for independent students.

Figure 4.4.1

Nelson-Aalen Cumulative Hazard - Gender - GMU

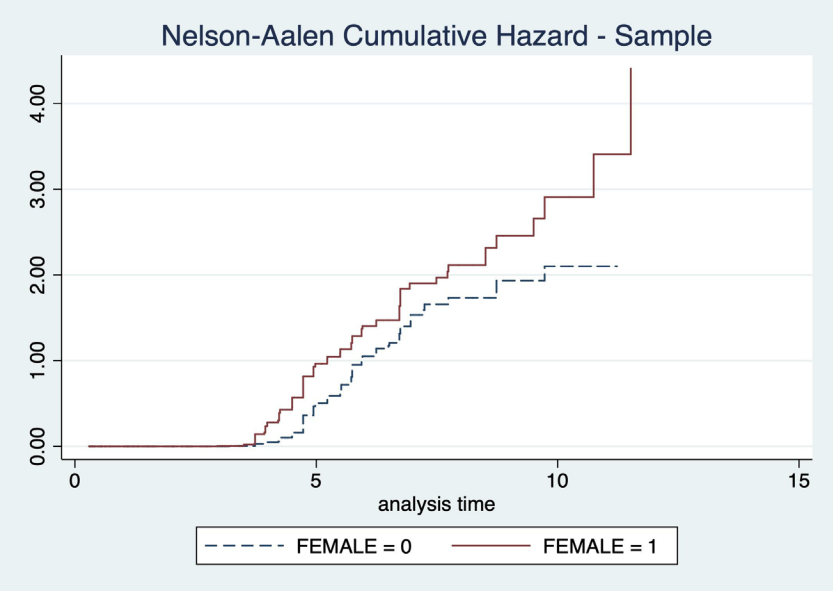
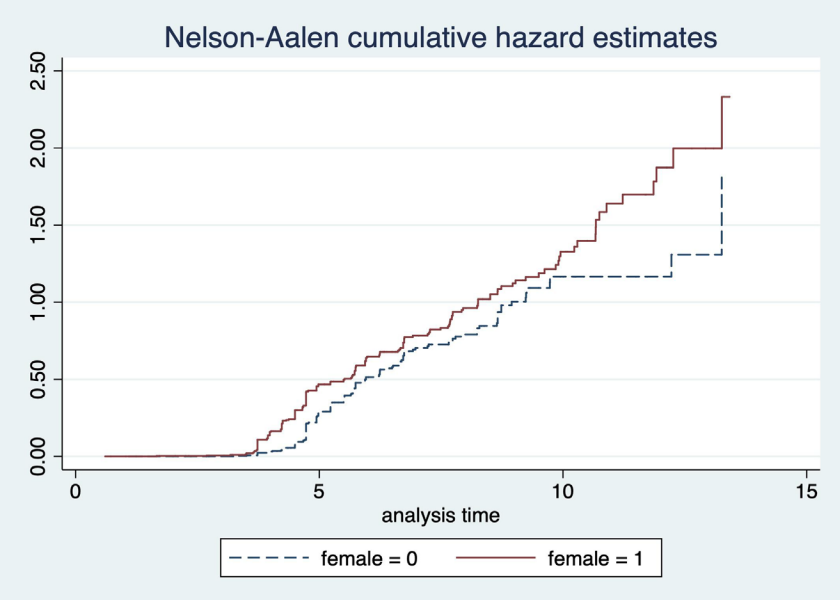


Figure 4.4.2

Nelson-Aalen Cumulative Hazard - Gender - Any Four-Year Institution



Viewing the Nelson-Aalen estimate was not intuitive for income groups as there were five separate hazards (see Fig. 4.5.1 and 4.5.2). Test statistics indicate income groups had a significant difference in degree attainment in both data sets. Both graphs

show that moderate/high incomes were exposed to greater risk of degree earlier in the timeline and the proportion of students obtaining a degree at Golden Mountain University was much larger at year six than other income groups. Further, students of low, very low, and extremely low incomes have lower cumulative risk at earlier time periods as the moderate/high income students. As was evident in the distribution of billed aid for students of extremely low income, this group continued to have students present in the pool after year ten and increasing hazards beyond year ten as they continued to experience the terminal event of degree attainment. However, when we observe data across institutions, with income held constant at the median seen at Golden Mountain University, all income groups continue to have observations beyond year ten. This can be attributed to change in dependency status and its resultant shifts in financial information collected, which is discussed later in the model results. While few students remained in observation beyond year ten at Golden Mountain University, the right tail of the Nelson-Aalen hazards show degree events were still taking place for students given the vertical jumps.

Fig. 4.5.1

Nelson-Aalen Cumulative Hazard by Income Group - GMU

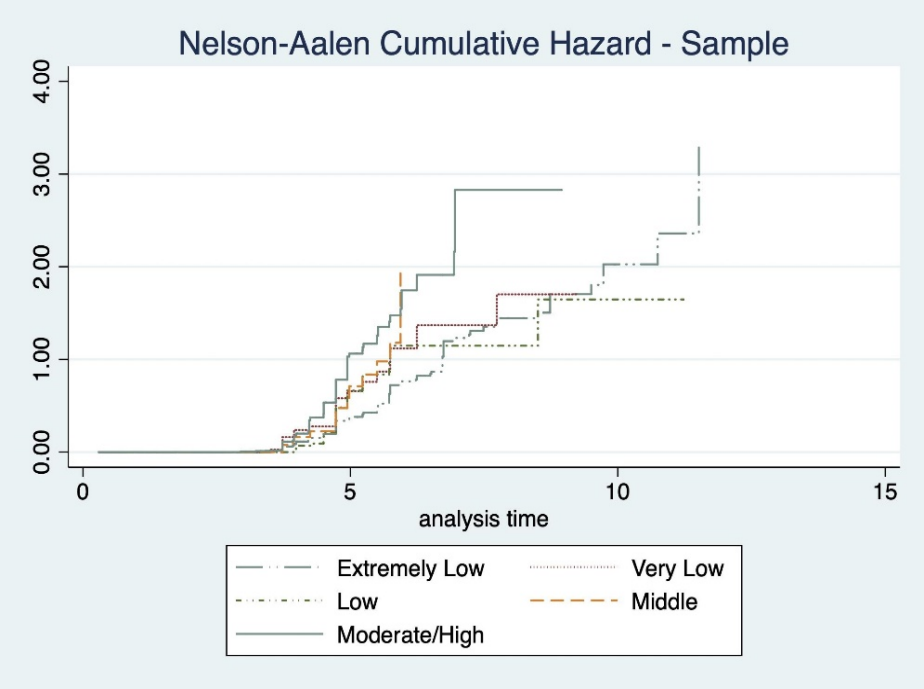
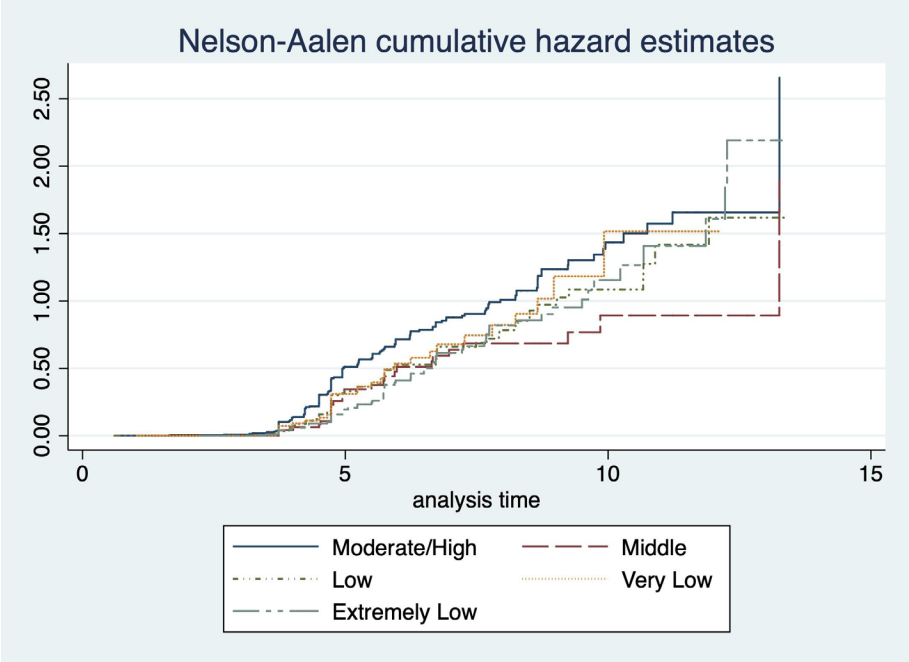


Fig. 4.5.2

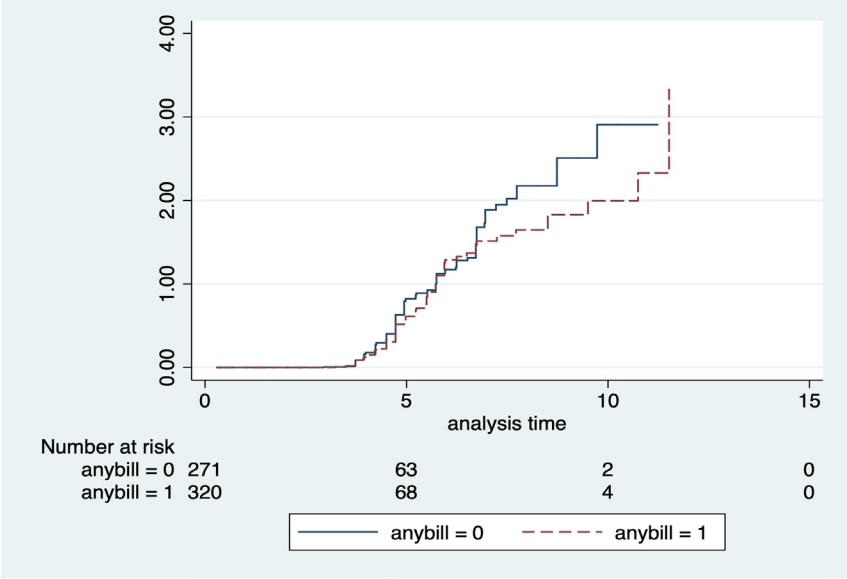
Nelson-Aalen Cumulative Hazard by Income Group - Any Four-Year Institution



Finally, comparing R2T4 treatment is difficult as it is time-varying. Figure 4.6 is presented for a base comparison between those who experienced treatment and those who did not in the sample, but it is important to understand that categorization of a treatment which occurs at varying points of time may mask true effects. Similar data is not available across institutions as R2T4 data is stored locally. Students in the sample who experienced a bill (320) survived in greater proportion than students who did not experience a bill, meaning they tended to stay enrolled for longer periods at Golden Mountain University. Additionally, students who experienced a bill have slightly less incline in the slope of the cumulative hazard as opposed to those in the sample who did not experience a bill, indicating they experienced the terminal event of degree at lower proportions. However, the Nelson-Aalen hazards cross twice during the observed time as seen in Figure 4.6, suggesting differences may occur by chance. The event history analysis that follows addressed the limitations of nonparametric analysis for this time varying treatment.

Fig. 4.6

Nelson-Aalen Cumulative Hazard (right) - Bill Group



Model Results

The descriptives and nonparametric analyses provided a basic understanding of the sample, including how the sample differed from the population in average and median time to degree, in data elements which may contribute to the outcome of time to degree attainment, and how those characteristics played out in terms of survival time and cumulative risk of degree. The following section moves into the results of analysis on how the identified characteristics, most importantly how R2T4 treatment, is correlated with time to degree and degree attainment.

This section begins with a description of the R2T4 billed aid across time and incomes, including information on enrollment in subsequent terms, followed by results for treatment on time to degree at Golden Mountain University, then results for treatment on time to degree at any institution, and concludes with a brief summary of the results.

R2T4 Financial Aid Bills Across Incomes and Across Time

The 591 students in the sample experienced a total of 677 withdrawal events at Golden Mountain University. A withdrawal event triggers the R2T4 treatment, where the billing of aid can be zero through some positive amount. About 54% of the sample, or 319 students, experienced a total of 358 instances of bill greater than zero dollars. A majority, 127 instances of billed aid greater than zero dollars was applied to students in moderate/high income, 31 to middle income, 55 to low income, 40 to very low income, and 63 to extremely low income students. Of those billed 177 enrolled at Golden Mountain University in the subsequent term. This left 319 withdrawal events that resulted in a zero bill per the R2T4 policy. Of these withdrawal events which resulted in zero dollars billed, 82 occurred with extremely low income students, 24 with very low, 41 with low, 31 with middle, and 183 with moderate/high income students.

As mentioned in the methods section, income groups were defined using HUD published data for California from 2011. About 10% of the 6,386 observations showed change in students' income groups from term to term. The highest count for change at 105 observations was those who transition from extremely low to moderate/high income groups for dependents. Otherwise income is relatively stable across years until the change in dependency status when students fall into lower income brackets benefiting from increased federal aid eligibility (Dynarski & Wiederspan, 2012).

The shift in dependency status necessitated review of income on this basis as the FAFSA relies solely on the student's information to determine the EFC (Federal Student Aid, 2017). Students who previously came from higher income families showed in the extremely low and very low income groups at transition to independent status, accounting for about 45 observations. There were only 224 observations beyond year six that would be primarily independent status students, another clue as to why the survivor and hazard functions earlier in this chapter were volatile at the latter end of time. Finally, of the sixteen independent students who experienced a bill greater than zero, twelve were previously categorized in moderate/high incomes as dependent students. The remaining 342 bills were applied to dependent students.

Moderate/high income students make up the largest share of withdrawal events, instances of a R2T4 bill at zero or a positive amount, instances of R2T4 bills for independent students (based on their family income prior to qualifying as independent), and share of Golden Mountain University degrees of those who conferred and were billed as result of the R2T4 policy. Students in low and very low income groups had more instances of withdrawal resulting in a R2T4 bill greater than zero dollars, whereas students in the extremely low income group had more instances of withdrawal resulting

in zero dollars billed. While no strong conclusions can be drawn from these observations, they do suggest several scenarios: 1) students in lower income groups are less likely to withdraw during the period of the term where a bill would apply than moderate/high income students, 2) students in lower income groups may be less likely to re-enroll after being billed, 3) there may be unobserved knowledge students in the extremely low income group have about the policy cutoff date; 4) students in moderate/high income groups persist regardless of bill at Golden Mountain University, and/or 5) the defined income range may be too restrictive for moderate/high income for the sample causing this group to appear as the largest share in all measures of distribution of R2T4.

Figure 4.7

Billed Amount ($) Greater than Zero by Income Group Over Time in Years

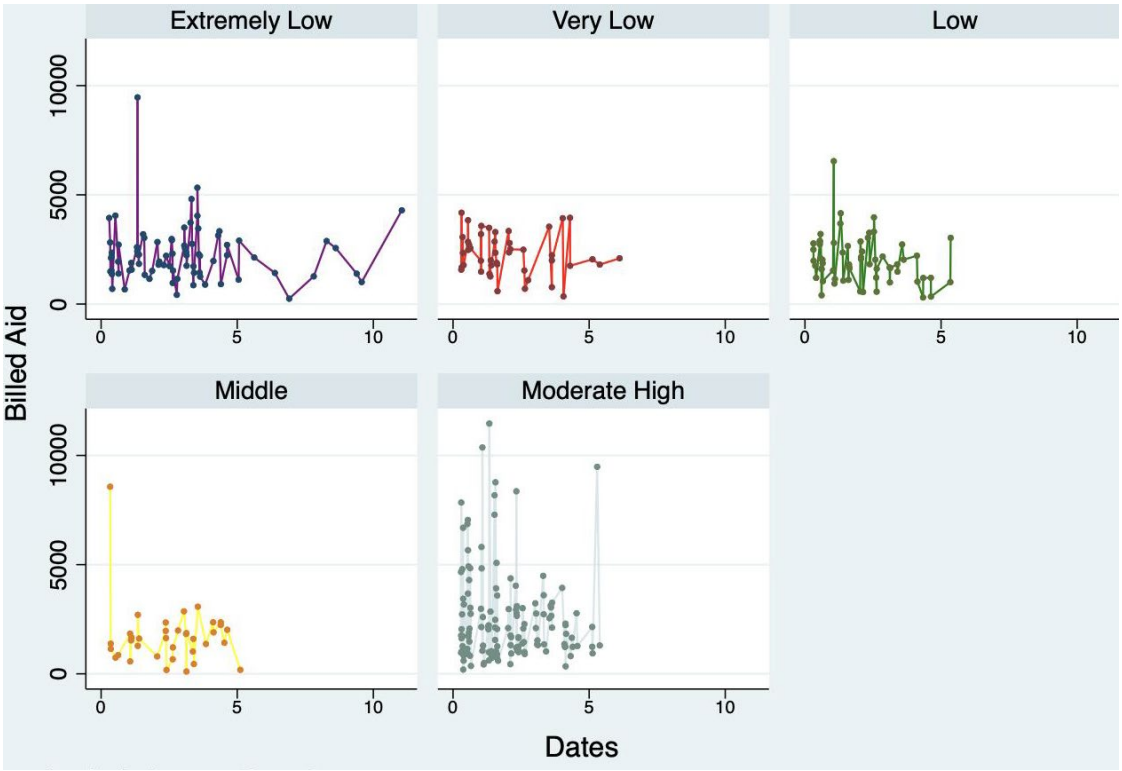


Figure 4.7 provides a visual of the distribution of bills by income group and time from information from the Golden Mountain University dataset. Financial aid bills tied to

the R2T4 policy are unknown at other colleges as the information is stored locally. However, the second model contained information on all withdrawal events and subsequent enrollment periods. By matching bill dates from the Golden Mountain University data to National Student Clearinghouse enrollment records, the data showed that of the 358 instances of R2T4 bill documented at Golden Mountain University, 160 resulted in enrollment at another institution in the subsequent term, with over 90% at a community college. Sixty of these students who enrolled at another institution were of moderate/high income, ten middle income, 31 low income, 23 very low income, and 33 extremely low income. This equates to more than two-thirds of extremely low income students enrolling in an alternative college versus less than half of moderate/high income students (excludes independents who transitioned from moderate/high income).

Billed aid continued throughout the observation window for students in the extremely low income group, but dependency shifts mask the true family financial strength for most beyond year six as discussed previously. Students in moderate/high incomes experienced greater volatility and the largest range in billed amounts if they were treated with the R2T4 policy. Amounts ranged from a minimum of $109 to $11,461 (see Table 4.7). Table 4.8 shows frequency of the R2T4 bill over time, with the highest incidence occurring in years one through three.

Table 8

Descriptive Statistics of R2T4 Bill Across Income Groups

	Obs	Min	Max	Mean	SD
Moderate/High	137	-11461	-196	-2558	2149
Middle	36	-8570	-109	-1704	1398
Low	61	-6543	-301	-1999	1084
Very Low	45	-4181	-351	-2296	949
Extremely Low	79	-9462	-247	-2270	1294
_n	*358*				

Table 9

Descriptive Statistics of R2T4 Bill Across Time

	Obs	Min	Max	Mean	SD
Year One	82	-8570	-195	-2491	1733
Year Two	87	-11461	-431	-2566	2197
Year Three	75	-8359	-179	-1981	1189
Year Four	57	-5328	-109	-2257	1008
Year Five	35	-3949	-301	-1860	1007
Year Six	13	-9481	-183	-2256	2316
Year Seven	3	-2094	-247	-1255	935
Year Eight	1	-1267	-1267	-1267	-
Year Nine	2	-2884	-2563	-2724	271
Year Ten	2	-1390	-1008	-1199	271
Year Twelve	1	-4291	-4291	-4291	-
_n	*358*				

Note: Year Eleven omitted as no R2T4 bill occurred at Golden Mountain University for any of the sample in that enrollment period

The drastic change of income for those who entered as freshmen and become independent by age, and low treatment dosage and student count as time progresses, suggests that the federally defined normative time to degree of six years for a bachelors program may be best suited as a study window when evaluating aid policy at one institution.

We understand several key concepts about the distribution of R2T4 bills. The first is that R2T4 bills only applied to about half of all withdrawal events at Golden Mountain University. The second is that the moderate/high income group comprised nearly half of

all withdrawal events and made up the largest number of R2T4 bills, though the HUD defined income ranges may be too low for this group. Third, changes in income are greatest for those previously identified as extremely low income who then transition to moderate/high income, but income was relatively stable over time over the whole of the sample. Fourth, extremely low income students were more likely to enroll at an alternative college after experiencing a bill, as compared to those from moderate/high income who tend to continue enrollment at the home campus. Finally, dependency status changes mask family income strength and can convolute treatment effects at the latter end of time.

R2T4 and Time to Degree at Golden Mountain University (Model A)

The following section addresses the first core research question of the study. First, I cover model set up, including statistical tests for multicollinearity, issues with measurement that arose, and alternative paths to address power and simultaneity. I then detail the results of the base event history model, model with interactions, and the final model with fixed effects.

With an understanding of the distribution of R2T4 bills across time, incomes, and dependency status, I turned to a semi-parametric survival model, known as the Cox model, to answer the core research question of how the R2T4 bill correlates with time to degree at Golden Mountain University. Multicollinearity was addressed by regressing the independent variables on stop time by observation, and running variance inflation factor and correlation tests (Allison, 2019). This revealed moderate to high correlation for a few pairs of variables. State gift aid was omitted from analysis given state policy requires it be adjusted to match existing tuition fees at time of withdrawal (so no resulting debit), as

well as its high correlation with university grant (β=.5841) and moderate correlation with federal grant (β=.3957).

To improve power and address the correlation of aid variables, two new variables were created that consolidated federal, university and other gift aid and another which summed subsidized, unsubsidized, Perkins, and private student loans by observation period. Additionally, cumulative college GPA was formed as college term GPA was highly correlated with college credits and moderately correlated with the treatment variable, billed aid. College term GPA and credits were removed. While cumulative GPA maintained moderate correlation with the treatment variable, it was maintained as past research indicated it was an important factor in student persistence (Chen, 2008; Chen & St. John, 2011; DesJardins, et al., 2002).

A histogram of the treatment variable of billed aid revealed a substantial number of zero bills and very few instances of amounts greater than zero (<6% of observations). Given the occurrence of the bill modifies the stop date on the record and due to the extensive information provided of other covariates, the baseline EHA model failed to measure the effect of treatment or determined perfect prediction of billed aid to degree attainment. Perfect prediction is a symptom of collinearity of the binary outcome with another continuous covariate in the model, or a symptom of too small a sample for the given distribution of the data (UCLA Statistical Consulting Group, n.d.).

Two paths could be taken to address the issue as suggested by Allison (2019), Singer and Willett (2003), and Yamaguchi (1991): 1) collapse a predictor into a binary treatment variable, and 2) lag the binary bill variable by one time period. The drawback to these methods was the loss of information to accurately determine the influence of a financial aid bill by dollar, and using an outcome which only partially answers the

research question. However, transforming billed aid from negative dollars to a binary variable increased frequency of measure and the models processed the effect. Lagging treatment counteracted the simultaneity of treatment on time. While pursuit of these alternative measures did not hone in on how change in billed dollars affects time to degree, it did allow the model to determine the influence of treatment, while correcting for simultaneity of the treatment on stop time. The following are the results of these paths.

New Measures for Independent Variable

I created two new key independent variables, one which measured bill as a yes or no at each time period and another which grouped students by whether or not they experienced a bill during their career. Grouping students into a variable by whether or not they experienced a bill allowed the model to measure differences between groups controlling for other covariates. Those who experienced a bill have a hazard of degree 3% greater than those who did not experience a bill, but this outcome was not statistically significant ($p=.823$) and so could occur by chance. This outcome is also incongruous with my hypothesis, but may be explained by endogeneity which occurs with the covariates in the model and risk of withdrawal. The event of withdrawal increased the opportunity to experience a bill, thus grouping students only added to the complexity of the model and failed to provide an answer to the core research question.

The second binary variable I tested identified whether a student was billed at the end of each observation period. This did not produce a measure when evaluated at the period of withdrawal due to simultaneity, the same issue when using billed aid by amount at time of withdrawal. A financial aid bill occurs upon a student's discontinued enrollment which modifies the observation window through adjustment of stop time, thus

the instantaneous effect of the bill is unable to be measured. Yamaguchi (1991) suggests that relative time or spacing of events, in this case the instance of being billed on continued progress to degree, may necessitate the use of lagged variables which vary over time.

Lagging Treatment

Lagging the effect of a bill by one time period produced measurable and statistically significant results as seen in Table 4.5. Sensitivity analysis demonstrated change to the coefficient and for lagged bill and its p-value, suggesting censoring of cases may be related to the covariates within the model which can bias estimates (Allison, 2019; Allison, 2014; Ranganathan & Pramesh, 2012). This is disconcerting as the semi-parametric model assumes non-informative censoring, meaning that cases that drop out of observation without experiencing the terminal event do so randomly (Singer & Willett, 2003). If students drop out of observation for reasons related to the covariates in the model, then estimates may be biased or erroneous. Yet, in this study, censoring of cases may be attributed to the event of billed aid which is the area of interest and would be an expected condition.

To address the possibility of informative censoring, I used fixed effects for withdrawal count by student, as DesJardins & McCall (2010) found that students who withdrew (stopped out) were more likely to experience a subsequent withdrawal event. This probability increased with each withdrawal event. I stratified the model by risk group, or groups which identify the number of withdrawal events experienced in the observation window to account for higher frailty. This improved model fit and sensitivity analysis, though informative censoring could not be completely discounted. Results for degree attainment at Golden Mountain University must be considered with caution.

Results

The Cox model indicates general relationships between the covariates and time to degree, but assumes proportional hazards over time. Tests showed this assumption did not hold for gender, gift aid, and student loan. Stratification and interaction with time are suggested as tools to correct for violations of proportionality (Allison, 2019; Allison, 2014; Box-Steffensmeier & Jones, 2004). Stratification corrects for proportionality for categorical variables, but removes these variables from the model. It allows the coefficients of other covariates to be average change across each stratum of the categorical variable, with differing base hazards between groups. Interaction corrects for proportionality of time-varying covariates. It maintains the continuous variable in the main model, while addressing how the hazard changes across time. As gender has been found to be important to persistence and completion (Chen, 2008; Conger & Long, 2010), I maintained this variable in the model. The risk of retaining a covariate which may not hold proportionality means that the hazard ratio is an average of the difference in risk between those who identify as female and those who do not at any point across the observation period. However, this average hazard may differ from the observed average hazard across time.

An instance of a bill is associated with 58.6% reduced risk of degree attainment as compared with someone without a bill during the observation period controlling for all other covariates (HR= 0.413, $p<.01$). This indicates these students survived longer in the dataset controlling for all other variables. Additionally, gender, dependency status, gift aid, and cumulative college GPA also showed statistically significant relationships to degree attainment. Students who identified as female were associated with a 62% increased risk of degree attainment, though this average may not hold at all points of

time. An independent student had 34.1% (HR=0.341, p<.001) of the risk of graduating as compared to a dependent student. Appendix B show their predicted survival probabilities when all other covariates are standardized, where females are more likely to graduate at earlier points in time thus reducing their survival probability in relation to those who do not identify as female. Students who were classified as independent have a higher probability of survival over time, though the distributions have a steeper slope that may be attributed to change in status when students reach age 24 (approximately six years).

Gift aid and cumulative GPA were also large factors in time to degree at Golden Mountain University for the sample. Every $1,000 increase in gift aid translates to about 20% reduced likelihood of graduating, though this correlation is very small relative to other risks and approaches a zero difference over time. While counterintuitive, using disbursed aid may convolute the findings for this covariate due to selection bias and endogeneity. Students who receive larger amounts of gift aid are also more likely to be low-income and have increased risk of not completing degree, and disbursed amount is contingent upon a student accepting the aid which may be influenced by other individual characteristics (DesJardins et al., 2010). I retained original amount disbursed, as I was interested in the adjustment of aid which can only occur for aid disbursed and I had little interest in the effect of aid offered on degree attainment. Finally, cumulative GPA showed a highly significant and very large positive risk difference in time to degree (HR=3.526, p<.001). Every unit of GPA increase is associated with over 250% increase in hazard for experiencing degree attainment.

This model (Table 10) explains approximately 26.5% of the variation in time to degree as calculated using the generalized R^2. This is defined as R^2=1-$exp(\frac{-G^2}{n})$, where n is the sample size the G^2 the likelihood-ratio chi-square for testing the null hypothesis

that all coefficients are zero (Magee, 1990). For comparison, prior models which violated proportional hazards and indicated there may be informative censoring, Appendices C, D and F, show modest changes in hazards and p-values between models. This indicates that while the final model provides the best fit for the data and in the midst of potential violations of model assumptions, this analysis does not swing wildly, which supports additional confidence in the model outcomes. Additionally, postestimation of the cumulative hazard against predicted Cox-Snell residuals showed the model with fixed effects for withdrawal risk group and interactions for gift aid was a better fit than the alternative model which corrected for proportionality (see Appendix E).

Table 10

Final EHA Model Estimates for Degree at GMU with Interactions and Fixed Effects for Withdrawal Risk Group

Variables	H(t)	Std. Error	P-value
Lagged Bill	0.413	0.14	0.007
Female	1.616	0.22	0.000
Underrep. Ethnicity	1.225	0.18	0.135
Housing	1.225	0.27	0.360
Parent Education			
High School	1.427	0.52	0.329
Bachelor and beyond	1.098	0.40	0.797
Other	1.056	0.43	0.893
High School GPA	0.767	0.16	0.211
Independent	0.341	0.09	0.000
Residency	0.651	0.47	0.552
Total Income	1.000	0.00	0.603
Net Worth	1.000	0.00	0.830
Student Employment	1.000	0.00	0.194
Gift Aid	0.9998	0.00	0.000
Student Loan	1.000	0.00	0.071
Parent Loan	1.000	0.00	0.967
Cumulative College GPA	3.526	0.57	0.000
Gift Aid x _t^2	1	0.00	0.005

Note: Fixed effects are included as strata for the number of withdrawal events. Hazards rounded to the nearest thousandth.

Earlier I spoke of clues about how the hazard may vary beyond year six as students from high/moderate incomes remain in the data but are then classified in lower incomes as the FAFSA only collects student income/asset information. The Cox model

allows for refitting the model for different ranges of time. At time more than the six years equivalent, the lagged bill was no longer significant (HR=0.57, p=0.0535), where modeling at time up to six years revealed significant relationship of the bill and degree attainment (HR=0.476, p=0.042). This indicates the EHA model with interactions may not be a good fit for time beyond six years at this institution.

R2T4 and Time to Degree at Any Four-Year Institution (Model B)

The model for time to degree at Golden Mountain University demonstrated a statistically significant relationship with R2T4 treatment. However, as detailed in the descriptives on mean and median time to degree for both data sets, there were large swaths of information that Model A did not account for, including enrollment time at all institutions attended and their organization type as recorded by the National Student Clearinghouse.

The baseline model with main effects (Appendix G) reports results for time variant and time invariant covariates and reveals their general relationship on time to degree attainment, with continued enrollment without degree as reference. The hazard, standard errors, and p-values are reported, where the hazard ratio, H(t), is the instantaneous average risk difference across time for a one unit change in the predictor variable. Tests showed violations of the assumption of proportionality for gender and organization type. Research demonstrates that gender is important to student persistence so was retained in the model (Chen, 2008; Conger & Long, 2010). As mentioned in results for Model A, the risk of retaining a covariate which may not hold proportionality means that the hazard ratio is an average of the difference in risk between those who identify as female and those who do not at any point across the observation period. However, this average hazard may differ from the observed average hazard across time. I

corrected for lack of proportionality for organization type by interacting this time-varying covariate with cubic time. This model produced relatively the same hazard ratio as the base model for the experience of a R2T4 bill, with students experiencing a 64.4% reduction in risk of degree attainment and an increase in their survival probability. The final step was to include an interaction between income group and lagged bill (Appendix H), but this failed to produce measures for middle and very low income interactions. Low and extremely low income groups did not produce statistically significant effects, which indicated the model was not suited to the data.

Postestimation statistics showed that the Akaike's and Schwarz's Bayesian information criteria were lower for the base model without interactions, but the Cox Snell residuals using the Nelson-Aalen cumulative hazard showed a better fit for the model with organization type interacted with time. A test of fixed effects for withdrawal events did not yield a better fit as it had with Model A. Thus, while the interaction effect for organization type was close to a hazard of one, which is indicative of minimal relative change in main effect on degree over time, the base model with this interaction was retained as the final model.

Table 11 shows that a financial aid bill as result of the R2T4 policy in a prior term is associated with a 64.4% decrease in risk of experiencing degree completion from any four-year university (HR=0.356, $p<.05$) across time. As mentioned earlier in discussion on methods, the Cox model is flexible but at the cost of keeping the baseline unspecified. The effect size is thereby difficult to measure, but the large difference from a hazard of 1 indicates there is a large difference between those who experience a bill greater than zero dollars and those who do not experience a bill. Additionally, gender, percent time enrolled, organization type, and low and extremely low income also showed statistically

significant relationships with degree attainment. Gender had a strong positive relationship to degree attainment, with students who identified as female having 49% higher risk for degree than those who did not identify as female. Students who enrolled at three quarter or half time enrollment show a decreased hazard from students who enroll full time, indicating students remain enrolled for longer periods of time without degree. Organization type must be interpreted with caution as students who earned a certificate or associate's degree are not considered to have completed a degree for this study. However, of note is that students who attend private four-year institutions have about 37% of the risk of a degree of those who attend public four-year institutions.

Table 11 *Baseline EHA for Degree at Any 4-Year College with TVC*

Variables	H(t)	Std. Error	P-value
Lagged Bill	0.356	0.15	0.013
Female	1.490	0.17	0.000
Underrep. Ethnicity	1.115	0.14	0.381
High School GPA	1.26	0.24	0.218
Pell	1	0.00	0.989
Student Loan	1	0.00	0.767
Percent Time			
Three Quarter	0.359	0.11	0.001
Half time	0.634	0.12	0.015
Less than half time	0.745	0.19	0.240
Organization Type			
Private 4-year	0.372	0.11	0.001
Public 2-Year	0.046	0.02	0.000
Parent Education			
High School	1.159	0.33	0.607
College or beyond	1.213	0.34	0.491
Other	0.874	0.27	0.659
Income Group			
Middle	0.773	0.17	0.240
Low	0.698	0.11	0.028
Very Low	0.813	0.17	0.316
Extremely Low	0.725	0.12	0.047
Organization Type x _t^3			
Private Four Year	1	0.00	0.200
Public Two Year	1	0.00	0.000

This model explains approximately 41.8% of the variation in time to degree as calculated using the generalized R^2. This is a jump from the variance explained by Model A (R^2=0.265) despite Model B having less information. Model B does not contain all varied aid types and amounts by term, academic progress in the form of cumulative college GPA or credits earned, housing type, residency classification, or dependency status. However, of these factors only dependency status and cumulative GPA had significant effects on time to degree at Golden Mountain University. Further, Model B has the benefit of organization type by time period to control for organizational effects, information found to be important in conceptual and theoretical frameworks for persistence models (Chen, 2008). The additional variance explained in Model B, suggests that Model A may suffer from endogeneity between covariates, or was overspecified.

Summary of Findings

There were three objectives for this study. The first was to explore the distribution of billed aid over time for students who withdraw through descriptive statistics. The second and third were to evaluate how intraterm aid changes influence student success via degree attainment at their starting institution, and at any four-year institution. These objectives addressed the research problem surrounding an understudied federal financial aid policy, Return to Title IV (R2T4), and its unintended consequences on time to degree and completion for vulnerable populations. R2T4 was part of the original Higher Education Act (1965) and has served as an accountability tool for both students and colleges that administer federal financial aid.

How do amounts billed students as result of the Return to Title IV (R2T4) policy vary across incomes and across time?

There were 358 instances of a R2T4 bill greater than zero dollars which occurred from 108 days to 4035 days of enrollment time. This represents treatment for about half of all withdrawal events for the sample. Students in the moderate/high income group had the greatest volatility in bill amount and widest deviation from the mean (SD= 2149.23), as well as the largest share of R2T4 bills at 38% for one income group. Extremely low income students showed the longest time distribution of bill amounts greater than zero, though most of these students originated from higher income families at higher ends of time. Once reaching age 24 they are independent by age per the federal aid definition, and were no longer required to report parent financial information. Average billed amounts greater than zero ranged from -1999.44 to -2557.64 across income groups. The highest frequency of billed aid as result of R2T4 occurs in years one through three of a student's academic career.

For those who withdraw, how does the amount of billed aid as result of R2T4 affect time to degree and degree completion at Golden Mountain University?

Billed aid could not be measured or showed perfect prediction in EHA models. This indicated low frequency and insufficient power, as well as revealed an issue of simultaneity of the bill date modifying stop time of an observation. A histogram revealed amounts greater than zero represented less than 6% of the observations. Low incidence rate of a bill was exacerbated in the model when measured by dollar. These modeling issues called for transformation of the outcome into a lagged binary variable by observation to assess the correlation of billed aid with degree completion.

The median graduation time at Golden Mountain University was 4.94 years and average degree time was 4.16 years. The lagged instance of bill shows a 58.6% average reduced risk of degree at Golden Mountain University as compared to no bill, assuming different baseline hazards for students with different numbers of withdrawal events, controlling for all other covariates and including time interactions for gift aid. However, I could not confirm lack of informative censoring which can lead to biased survival estimates, though tests for this particular model showed the least volatility and most confidence. Postestimation of the cumulative hazard against Cox Snell residuals fit well, indicating the model was a good fit for the data (See Appendix I).

Of those students who withdraw from Golden Mountain University, how does the amount of billed aid influence their time to degree and degree completion at any institution?

The median graduation time for the sample when reviewing National Student Clearinghouse data was 6.72 years, and average degree time was 6.29 years. The event history analysis semi-parametric model with interactions for organization type showed an average 64.4% decreased risk in degree completion across time from any four year university for 590 students of the original sample of who withdrew at least once from Golden Mountain University and were financial aid applicants.

Discussion on meaning of these findings, implications for future research and practices, as well as the significance of this study follow in Chapter Five.

CHAPTER 5: DISCUSSION AND IMPLICATIONS

The following chapter is organized into four sections: 1) a brief overview of findings and limitations of past financial aid and persistence/degree research, followed by 2) a discussion of the findings and how this study addressed past research limitations, 3) implications of this study for future research and practice, and 4) an explanation of the importance of this study.

Studies on financial aid in relationship with persistence and attainment have consistently reviewed initial or final aid awarded or disbursed (Alon, 2011; DesJardins, 2003; DesJardins et al., 2002; Ishitani, 2006; Li, 2008; St. John et al., 2005). On the whole, findings demonstrate a positive relationship between financial aid and student persistence with mixed results on direct effect of aid on attainment (DesJardins, et al., 2002; Dowd, 2004; Gross & Berry, 2015; Gross et al., 2014; Gross at al., 2012; Lim 2008; Mendoza et al., 2009; Proudfit, 2014) and on what types of aid are of greatest benefit (DesJardins, et al., 2002; Gross & Berry, 2015; Mendoza, et al., 2009). Further, studies on accountability measures in the aid process (application, information transparency, institutional controls, etc.) have demonstrated minimal efficiency in targeting of aid funds (Darolia, 2013; Dynarski & Clayton, 2013; Dynarski & Clayton, 2008) with detrimental effects on access and enrollment in higher education for underrepresented groups (Campbell et al., 2015; Darolia, 2013). As one measure of accountability, R2T4 represents over a quarter of the Federal Student Aid Handbook (Federal Student Aid, 2017), and has not been present in the literature. The limited access to detailed, student level data and the ability to track students across institutions, continue to be barriers to this type of research on student behavior in relation to mid-term aid changes.

Discussion of Findings

The current study addressed limitations of past research on financial aid and attainment by exploring how federal aid policy tied to aid reduction influences student time to degree. Using a semi-parametric event history model on a sample of first-time freshmen aid applicants who experienced at least one withdrawal event at Golden Mountain University, I explored the relationship between R2T4 and time to degree at the home campus, and between R2T4 and completion at any four-year institution.

I framed this study using Chen's (2008) heterogeneous approach, which incorporates past theoretical frames on student persistence (e.g. sociological, psychological, interactionalist, etc.), as well as considering price elasticity and liquidity. These latter concepts hypothesize that a student's risk of dropout is predicated on interactions between aid and income. I adapted this to review interactions between the billing of aid and income, as well as including variables considered important to persistence. While Chen (2008) focuses on dropout risk, this is a related dependent event of degree attainment and so highlighted a practical use of this methodology.

R2T4 and Degree Completion

The findings of this study are novel as past research had yet to explore the relationship of mid-term aid changes on time to degree. The negative relationship between time to degree and the experience of a bill indicates this federal aid policy correlates with prolonged enrollment time and decreased risk of completion. While statistical tests require the outcomes be interpreted with caution in light of possible informative censoring (more about methods is discussed later in this chapter), there remained evidence of a relationship between R2T4 and time to degree completion.

There was no evidence of an interaction between a financial aid bill and income group or total income in either model, which suggests no difference in price elasticity and liquidity of the bill across incomes. However, I would argue that the categorization and low frequency of the bill may mask nuances in the data in this respect. While I could not substantiate different risks of degree across incomes in relation to the bill, this does not discount the influence of other types of wealth. Focusing on income alone may ignore cultural and social capital which may affect students' confidence in their ability to persist and complete their college degree (Aries & Seder, 2005). Enrollment at another college is also associated with other deferred costs to the student, including the cost of time and delayed social, cultural, and economic capital gains, as well as how finances at another institution may affect decisions to persist (Becker, 1994; Dynarski & Scott-Clayton, 2008; Paulsen & St. John, 2002).

R2T4 bills were most prevalent in years one through three of students' enrollment at Golden Mountain University. The distribution of billed aid was widest for students from moderate/high income, and this group also represented the majority of instances of billed aid and withdrawal of events of any single income group. The income range may be too restrictive for moderate/high definitions resulting in their higher counts. The ranges used in this study, as defined by the California Department of Housing and Development, do not capture regional differences. Future studies that seek to compare income groups may benefit from utilizing alternative income range definitions that parse out the moderate/high ranges with greater specificity.

Interestingly, students of extremely low income had more instances of no billed aid based on their total withdrawal events. The lower proportion of billed students who withdraw in the extremely low income group suggested either unobserved knowledge of

policy cut off dates for treatment, or higher rate of censorship after withdrawing from Golden Mountain University. The latter idea was supported by the large increase in enrollment time and higher incidence rate of enrollment at alternative higher education institutions (primarily public community colleges) for those of extremely low income in Model B. This pattern is consistent with perceptions of costs versus benefits and how this influences the college enrollment decisions of low-income students (Avery & Kaine, 2004). This also suggests that more precise estimates of differences in enrollment time may be evident with the closer outcome of re-enrollment and location of re-enrollment subsequent to the application of R2T4.

Other Findings

While mid-term aid changes are not specifically reviewed in the literature, other results from this study coincide with past research on persistence and degree attainment. Though not the focus of this study, the following discusses notable conclusions drawn from the present study on income, gender, gift aid, and ethnicity.

There was strong evidence that students who remain enrolled after treatment at Golden Mountain University have greater family financial strength. While total family income was not found to have influence time to degree in Model A, Kaplan Meier tests showed significant differences in degree attainment by income group which is consistent with past research (Soria, Weiner, & Lu, 2014; St. John, 2006). The lack of explanatory significance of the main effect of income on attainment may be the result of the complex nature of Model A and many aspects captured. For example, both income and financial aid variables were included in the model, the former shown to mediate financial aid (Mendoza, et al., 2009). Interestingly, DesJardins et al. (2002) suggested that family income may not be the best proxy as a student financial measure when they become

independent; however, the sample in the present study demonstrated using student income alone may mask resources those individuals have to remain enrolled and complete at the home institution. This was observed in Model B where the student's financial strength was categorized as constant at the median observed value at Golden Mountain University. This resulted in a statistically significant relationship between low and extremely low income and time to degree attainment for completion of a bachelors at any institution.

Students who identified as female were more likely to complete earlier than their peers, a finding consistent with past literature (Gross et al., 2014; Chen & Hossler, 2014). The sample was comprised of less females than the population, suggesting students who do not identify as female are both more likely to withdraw and less likely to complete. Cumulative college term GPA and enrollment time were both positively related to degree attainment. Gift aid held a negative relationship to time to degree, though this effect diminished over time. Additional gift aid has been found to improve college GPA to a point (Coria & Hoffman, 2015), which may have factored into why cumulative GPA was overwhelmingly a strong predictor of shortened time to degree and increased risk of attainment. Higher GPA contributing to degree attainment is intuitive as students who perform better academically are apt to persist and complete (Bates, 2012; DesJardins et al., 2002). The negative relationship of gift aid with degree attainment in Model A coincides with past works on underrepresented groups (Gross et al., 2014; Mendoza, et al., 2009), though differs from other studies on financial aid and attainment (DesJardins et al., 2002; Ishitani, 2006). The same effect of aid was not evident in Model B, though this may be due to omitted variable bias as we do not have information on institutional

aid at each campus, an important factor in reducing odds of stopout (DesJardins, et. al., 2010).

This study did not find a significant relationship between underrepresented ethnicity and time to degree across either model, which differs from past persistence research (Gross et al., 2014; Gross et al., 2013; Ishitani, 2006; St. John et al., 2005) where students from Latinx, Black, and other traditionally underrepresented groups show lower risk of degree completion. This may be explained by the binary dummy variable used for ethnicity in this study, and how this may mask differential effects between groups. Another consideration is the interconnected relationship between ethnicity, income and financial aid, where the participation of underrepresented groups at Golden Mountain University is reflective of their income backgrounds and of aid policies which mediate social and cultural capital in enrollment choices (Kim, 2011). It may also be that there was truly no measurable difference in this aspect as categorized for this sample of students from this particular campus.

Methods

In the course of conducting this study, several key methodological issues surfaced which may result in endogeneity and biased estimates, including simultaneity, omitted variable bias, unobserved heterogeneity, and self-selection bias. These issues were revealed through the additional information acquired from the second dataset which contained enrollment across institutions by organization type, sensitivity analysis, assessing frailty of the withdrawal sample to the population, and through measurement error of the treatment variable. The following addresses each of the methodological issues and suggestions on paths forward to reduce spurious results.

The first issue, simultaneity, was discovered early on in the study as my original research plan used the R2T4 billed aid amount by term as a key predictor of degree attainment. However, initial outputs omitted the coefficient of billed aid and the model indicated perfect prediction and collinearity. Review of additional works on longitudinal studies indicated that covariates which modify the observation window are collinear with the observed time and indicated to correct this issue through use of lagged effects. In addition to correction for the issue of simultaneity, researchers have argued for lagged effects due to duration dependence for stopout, persistence and attainment (DesJardins & McCall, 2010). Thus, future works must be cautious of treatment and how it interfaces with time as measured for evaluation.

Second, omitted variable bias, or lack of measure of a variable which is correlated with the dependent and independent variables, can lead to an over or under estimation of treatment (Cellini, 2008; Light, et al., 1990). This study had the advantage of reviewing two sets of data on enrollment for the same sample of students. This revealed the migratory patterns of students who withdraw and how the lack of the additional information on enrollment time and organization type can greatly reduce true survival times. In other words, the presence of additional enrollment time and organization type were omitted variables in Model A which correlated with our covariates and outcome. The advantage of the second data set was offset by its lack of institutional aid, academic progress, parent loan, housing, and residency classification at other institutions. The first two of these have been found to be important to assessing persistence to degree (DesJardins et al., 2002; Gross et al., 2007). However, robust data sets and honing in on the central goal of evaluation may attenuate the affect of omitted variable bias.

The base element of total enrollment time is unobserved in the first model, which contributed to the large difference of explanatory power between Model A and Model B, 26.5% and 41.8% respectively. This also plays into the issue of unobserved heterogeneity, or unmeasured differences between subjects that are related to students' proclivity to withdraw. There is always some level of unobserved heterogeneity, so hazards have a tendency to show as declining functions (Allison, 2019). This results in those with high individual risk for degree graduating earlier in time which removes them from this risk set, leaving more of those with lower hazards across time. Traditionally this is a difficult item to assess, though research on stopout and dropout risk provide suggestions to use fixed and random effects (Heller, 1999) with use of semi-parametric (Cox) survival models which assist in ameliorating this condition (DesJardins, 2003; Han & Hausman, 1990). Others suggest use of frailty models (Heckman & Singer, 1982), though estimation is computationally difficult and results tend to be unstable and depend on an assumed functional form of the dependence on time (Allison, 2019).

Aside from omitted variable bias and unobserved heterogeneity, self-selection is also a concern in observational studies. Self-selection is a highly probable condition for students from lower economic means in terms of disbursed aid, as they tend to be offered and accept larger amounts of gift aid based on their backgrounds. They have also been found to participate in behaviors that negatively affect academic progress (e.g. working more hours, skipping meals, lack of participation in study sessions, etc.) (Soria, et al., 2014), and are less likely to persist (Alon, 2011). Past researchers have used initial aid offered to control for selection bias (DesJardins, et al., 2002; DesJardins & McCall, 2010). An argument for using aid offered, is that disbursed aid makes it difficult to understand if students have different stopout changes from others who do not receive aid.

For example, the marginal negative effect of gift aid on time to degree in Model A may be incorrectly specified given gift aid amounts are indirectly informed by other variables in the model, including total income and net worth, academic performance, and residency, which are also elements which can affect a student's enrollment behavior. The present study used information on original disbursed financial aid amounts to address the basis of R2T4 treatment as this policy only applies to disbursed aid and not aid offered (Federal Student Aid, 2007). The present analysis was concerned only with those who could be billed, thus disbursed aid was the practical status of this variable to evaluate as those with zero disbursed aid would have a bill of zero. However, an argument could be made to utilize aid offered or aid applicant (DesJardins & McCall, 2010) to control for financial aid influence without the complexity of treatment interwoven with other observed covariates.

The methodological challenges which surfaced in this study confirmed the value of advanced statistical methods, including joint frailty models, regression discontinuity, propensity matched samples, and difference-in-difference approaches utilized in casual analysis for treatment in the presence of repeated and terminals events (Austin, 2011; Charles-Nelson, et al., 2019; Chen & Hossler, 2014; Hossler, 1999). Though each method has drawbacks, they provide opportunity to tease out confounding and evaluate true effects of financial aid policy. Finally, each data set held advantages, but still produced incomplete information about the sample which reduces the explanatory power of each model and points to a limitation of quantitative analysis in this line of research.

Implications for Research

The implications for research from this study are robust. First, this dissertation provides an understanding of an aid policy which has not been purposefully studied in the

past. Aside from the complexities of evaluating financial aid policy, restrictions on student level data with repeated measures across time are a substantial barrier to this work. Given current restrictions on financial aid data, future studies of this level could only occur in financial aid offices. The Department of Education has information on R2T4 as well, but does not collect repeated measures on institutional aid, college GPA, and other information found to influence student enrollment decisions. While research institutions may have the capability and resources to undertake this type of study, only those in financial aid administration have permission to access student level data for the purposes of informing local aid policy (Higher Education Act, 1965; U.S. Department of Education, Privacy Technical Assistance Center, 2017). This greatly narrows opportunity for future research at this level; however, some aid offices house a research staff person or unit. Exploring the influence of aid policy at a local level, will require additional aid offices to consider including researchers as part of their operations.

Second, the present study is one of the few to evaluate aid policy on time to degree, as opposed to a binary outcome. By using the outcome of time, differences to degree attainment can be assessed using average risk, and models can be extended to produce predictions with defined values of the covariates. While event history methods (survival analysis) is more widely used in econometrics and medical research, it is of great benefit in evaluating higher education policy, such as R2T4, which modifies aid over time. While robust, the complexity of student persistence and attainment requires researchers seek out additional techniques to reduce endogeneity.

This study confirmed difficulties in determining effective measures of treatment, time, unobserved heterogeneity, and endogeneity when taking a holistic approach to understanding student enrollment behavior. The difficulties in securing effects for billed

aid is indicative of the correlation of income on financial aid and academics, academics on proclivity to withdraw, all related to increases in time to degree. Additionally, the low incidence of a R2T4 bill reduced statistical power which resulted in transforming measure to a binary dummy variable. Thus, this study confirms prior research regarding the complexity of modeling financial aid policy effects (Chen & Hossler, 2014; Chen & DesJardins, 2010; DesJardins & McCall, 2010; DesJardins, 2003). Future studies may consider alternative measures for the R2T4 bill. For example, this model used original disbursed aid and a separate variable for billed amount. Instead, it may be advantageous to use final disbursed aid and when evaluating only those students who experienced a bill, or use status as aid applicant in addition to the billed aid amount. Additionally, issues of endogeneity and unobserved heterogeneity may be ameliorated by considering financial aid policy influence on an alternative outcome, re-enrollment, either across institutions or at home institution.

This study benefited from access to detailed campus level data tracked by dates, as well as access to enrollment and federal aid data across institutions. By reviewing a policy which penalizes students with discontinued enrollment, it is critical to collect data which capture repeated measures of enrollment time, academics, financial aid, family wealth, organization type, etc. to understand the affect on student enrollment behavior. Tracking students across institutions involves time and cost, two additional advantages available in the present study. The complex nature of student mobility (Chen & DesJardins, 2010; Chen & Hossler, 2014) highlights the importance of understanding both types of institutions at which students enroll, and true enrollment time for students who depart.

For all the methodological concerns described above, students who withdraw may be more likely to enroll in other colleges and universities, so if enrollment time is the salient concern, longitudinal studies which track students across time and institutions may be of greater relevance. Earlier I mentioned that students with bills sitting on their student account were not able to retrieve transcripts, so enrollment at other institutions either equates to enrolling at two-year colleges which do not require prior college credit to enroll, or a student may start their bachelor's degree program anew. In any case, capturing true enrollment time is important to model stability. As this study confirmed, degree outcomes given student mobility present challenges to measuring main effects of aid policy and programs as there are not currently databases which store institutional differences across multiple observation periods, such as institutional aid refund policies, academic resources, etc. The drastic difference in enrollment time to degree and institution type attended is again a testament to the importance and need of robust data sets which include all enrollment information across institutions.

Robust and complete data is a challenge for any quantitative study. The present study also found minor misalignments between the national enrollment database (National Student Clearinghouse) and home campus degree information. This is an aspect which researchers are aware, but is noted here as it contributes to the need for detailed and complete data. This also addresses a common struggle for researchers between utilizing detailed information which is typically bound at the institution level, and robust, but less detailed cross segment information. Though Model B sacrificed detail in aid and academic information, it provided a more accurate measure of time to degree, the core outcome of interest in this study.

Future research would benefit from taking alternative modeling approaches, including utilizing quasi experimental methods used in other research which consolidate explanatory and correlated variables, and approaching the question from a qualitative perspective. There was an opportunity to conduct a joint model for this study, but current software capability in the platform used, was limited to joint modeling of one survival outcome and a continuous, terminal longitudinal outcome. This did not fit the data and so was abandoned, but other statistical packages may hold promise in this area. Still, the practical implications of aid policy on student degree attainment may be masked in the quantitative approach via "explanatory variables." Quantitative approaches attempt to describe average effects, but cannot account for intermediary decisions individual students make which can impede time to degree.

With only about half of all withdrawal events resulting in a financial aid bill across more than a decade of observation, statistical power may be a concern in future research. The low frequency of treatment, limitations of quantitative methods, as well limits on financial aid data and its use, would support a qualitative approach in future research. Qualitative methods can step in to fill a gap about the lived experience of students who are billed by the R2T4 policy and how this influences their decision to persist at their home institution, at another institution, or to make alternative decisions which could have long term effects on their success in education, employment options, health, etc. This approach also opens opportunity to understand effects which may not be directly tied to the student. For example, intergenerational effects as result of a student experiencing a financial aid bill, or exploring how academic advisers balance guidance to students intending to withdraw with the understanding of the potential financial affect.

Implications for Policy and Practice

The findings in this study are relevant to concerns for policymakers and practitioners interested in the ways in which federal aid policy may modify the benefits of aid programs intended to close equity and achievement gaps. It also sheds light on the need for accessible databases which track students across institutions and with more measured data than is currently available, to understand the full effect of aid policy on enrollment time. In this regard, a key contribution of this study was the ability to model on two data sets representing the same sample, and how evaluating time to degree at one institution for students with a proclivity to withdraw greatly reduces true enrollment time and compromises the true scope of influence of aid policy.

Policymakers

Perception of federal aid policy as punitive, creates a climate of penalty that may reproduce inequities (Campbell, et al., 2015). The results of this study indicate a negative relationship of R2T4 and time to degree, when controlling for other student characteristics, academics, and financial aid. The sample was focused on students who experienced withdrawal, an event already associated to increased time to degree (DesJardins, et al., 2012; DesJardins & McCall, 2010). Policymakers should pay attention to the ways that accountability measures, in the form of aid policy, negate the benefits of these financial aid programs for those at lowest risk of persisting, including students who may be at higher risk of a withdrawal event. This study supports a review of R2T4 and suggests modification is needed to address its disproportionate impact on degree attainment among those at higher risk of withdrawing and failing to complete degree controlling for individual background characteristics.

Background characteristics, such as gender and dependency status, played a huge factor in degree attainment. As observed, students who identified as female represented a smaller share of the withdrawal sample as compared to the population, suggesting they are not only less likely to withdraw, but the event history model also demonstrated they are more likely to complete if they do withdraw. Independent students were in similar proportion in the sample and population, but the models showed they had a much lower conditional probability of graduating over the observation window. These results controlled for R2T4 bill, so the application of a bill on these two groups may exacerbate the declined hazard, or their conditional probability of experiencing the event of interest. These are important considerations as students not identifying as female are already at greater risk of stopout in the sample. The refitted Model A for time less than six years still demonstrated a declined hazard rate for independent students, those who may have children, be married, military or reservists, former foster youth, homeless youth, wards of the court, etc. Those without a support system, such as students without parents, or students with children, are at lower risk of persistence and attainment (Day et al., 2011; Goldrick-Rab & Sorenson, 2010). A policy which imposes another barrier to their persistence is bound to delay degree completion (more time equates to more cost) and to derail their opportunities post-college.

Accountability measures which were imposed to establish responsibility on institutions and students for federal aid funding, compromise the promise of equity of these programs. This study demonstrated the lower probability of attainment across time for those who experienced a bill. While no discernible difference could be ascertained of the bill across incomes in relation to degree completion, those of extremely low and low income did show a reduced hazard for completing. Given the complexity of the models

used in this study, price elasticity across incomes should not be a forgone conclusion for intermediate outcomes (e.g. stopout, dropout, re-enrollment). As detailed in chapter two, initial college enrollment decisions are made on perception of cost and financial aid (Kim, 2012), and federal and institutional aid have been shown to modify the negative relationship of income and improve persistence odds (Gross et al., 2007; Gross & Berry, 2015; Mendoza et al., 2009). Imposing a financial barrier to those with lower risk of persisting is bound to have negative consequences. What level of opportunity debt drives students away from college for good? This study did not assess R2T4 effect on student mobility, but the higher rate of enrollment at another institution for those of extremely low income suggests the policy may disproportionally affect these student's ability to persist at the home campus.

In addition to the barriers caused by an aid policy to at risk student groups, uncovering the true scope and influence of aid policy requires access to robust data across institutions. While privacy laws are in place to protect student information, the additional limits on use of aid data (even to those who work in financial aid offices) is problematic. This is an area which policymakers should address for the benefit of understanding how policy does or does not achieve intended goals and its unintended consequences for those with the most to lose. For example, precise causal estimates require repeated measures of variables across more granular measures of time and inclusion of campus level data, both aspects which are limited in national surveys. Thus, the most pressing issue for future research is relaxing the provision that studies of student aid data be limited to those pursuing "efficient and effective administration of student aid" (U.S. Department of Education, Privacy Technical Assistance Center, 2017). Student success measures are of high interest to college administrative officials, and studies which attempt to address how

campuses can improve persistence, retention, and graduation, cannot currently account for how financial aid factors into these outcomes. This is a significant disadvantage to institutions that may not have the capacity in their aid offices to conduct this level of research, but whose campuses may have other units with missions to achieve this type of work.

Finally, as this study utilized two data sets drawn from local and national databases, a benefit was the ability to compare data. This comparison revealed inconsistencies in degree information. For example, Golden Mountain University recorded 260 degrees earned at the home campus in the sample, whereas the National Student Clearinghouse (NSC) reported 259 degrees earned at the home campus. Further, in some instances, students who transferred back credits to Golden Mountain University to earn degree, did not show as conferred in the enrollment data record with NSC like other students, but did show as conferred on degree information in NSC. This is a cautionary item as often policy is driven by national databases, which may contain some level of data misalignment. The scope of this issue is not known, but depending upon how data are distributed and reported, information may not represent the true enrollment and attainment of a campus. This supports the perspective that aid policy developed as a one size fits all may be inappropriate (Campbell, et al., Davis et al., 2012) if informed by data which is incomplete or erroneous.

Campus Administrators

A few key considerations can be made by campus administrators from this study, including consideration of the quality of data sources, understanding information flow to students, implementing withdrawal prevention for at risk groups, and informing institutional aid policy on localized research of aid recipients.

As detailed previously, data misalignments between different sources may not be uncommon, but it is an item which should be understood by administrators who may use these external databases to collect information. Additionally, it is important for administrators to understand how data is being reported to these databases. Campus administrators may be best situated to utilize local campus data to inform campus based policy and student programming.

In addition to understanding the capabilities and limitations of data sources, this study revealed the potential for differences in how information on aid policy is consumed by students. Though less students from extremely low income backgrounds experienced a bill, they were more likely to enroll elsewhere than students of moderate/high income after treatment. Much like the hurdles experienced by students of lower economic means when attempting to access college (Paulsen & St. John, 2002; Becker, 1994), this presents an opportunity to map the withdrawal process and what and how information is disseminated about financial aid effects and costs for enrolling at another campus versus returning to Golden Mountain University. A majority of enrollment after treatment took place in community colleges, campuses with much lower sticker price. Though there may be many reasons for students to enroll in a community college, it may also be related to perception of lower net cost. The danger here is that students may not enroll in the courses needed to complete their bachelor's degree. While the present study was focused on bachelor's degree attainment, students in the sample did earn two-year certificates and degrees in the observation period after departure from Golden Mountain University. This indicates an opportunity for administrators to define how information can be improved prior to student departure on cost/benefits of enrolling at another institution, benefits of completing a four-year degree versus two-year certificate/degree, and the net cost of

earning the bachelor's degree. This in combination with programming recommendations that follow may help to increase persistence at the home campus.

Finally, administrators may consider programs/strategies to assist groups at most risk of not completing their degree of those who withdraw. This includes students classified as independent prior to age 24, those who do not identify as female, and those with lower income and is most important during the first three years of enrollment where most R2T4 activity occurs. These groups were particularly less likely to complete a degree in the sample, indicating a need for more focused persistence efforts and programming tailored to their needs. Additionally, less than half of all those billed by R2T4 re-enroll at the home campus, yet another reason for administrators to prevent student stopout. Understanding the nuances of gender, dependency status, and income on this behavior at the campus may necessitate another research study. However, the present research suggests that any student retention programming that did take place during the first three years of enrollment for these groups, may not be entirely effective for those with lower probability of degree. Further, analysis of frailty clearly indicates that the withdrawal sample is more alike than not in their proclivity to withdraw. Administrators need to consider how factors that cannot be measured may influence student stopout, such as family obligations, future family assistance, (Witkow et al., 2015); social belonging and integration (Kahu & Nelson, 2018; Soria et al., 2014), and motivation (Morrow & Ackermann, 2012).

Importance of the Study

This study was motivated by the opportunity to address local financial aid policy at Golden Mountain University in consideration of how federal aid policy influences time to degree for students of this campus. The findings are notable as they represent the first

exploration of an aid policy that reduces aid mid-term, as opposed to start or end of term evaluation, and its implications to students who withdraw. Additionally, the methods used represent the best strategy to evaluate a complex longitudinal model which measures treatment on time to a terminal event, accounting for omitted variable bias and unobserved heterogeneity. While the methods used cannot address all biases, they take the first step in understanding how this complex aid policy influences student behavior over time.

This study confirmed the complexity of studying aid policy, including addressing endogeneity and other model issues to reveal how a policy may negatively relate to degree attainment. A significant contribution of this study is in the contrast of two data sets of the same sample of students, which revealed the importance of the full scope of enrollment time across institutions and suggests that a heterogeneous approach to modeling time to degree may convolute outcomes at the institutional level.

As college cost and transparency continue to make headlines, this study offers the opportunity to weigh how federal policies may play into these issues. The complexity of the aid process has served as barrier to students at the access point of college. This complexity continues throughout a student's career. The effect of withdrawal is typically not known by a student until after they discontinue enrollment. The negative relationship of the bill to time to degree, as well as student mobility in this study, suggests the policy serves as another barrier during enrollment. Degree completion is often cited as a measure of institution success, but a policy like R2T4 that places financial barriers reduce students' opportunity to complete at the home campus. This affects overall completion rates of the home institution, a repercussion of federal aid policy.

This study provided a glimpse at the relationship of one aid policy on time to degree. There are several others that also reduce aid which are not measured in this study, but may serve as other opportunities to evaluate federal aid policy on persistence. This study contributes to discussion of accountability in the form of aid policy, and how aid regulations counteract the founding principles of federal student aid and adversely affect students from vulnerable populations.

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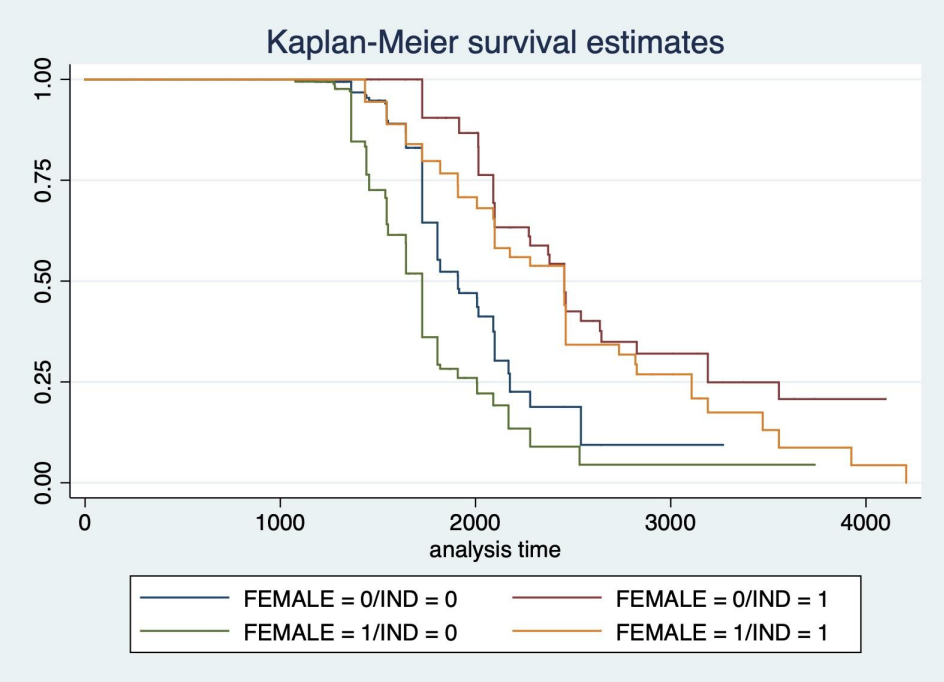
Appendix A: Kaplan Meier Estimates by Gender and Dependency

Kaplan-Meier Survival Estimates by Gender and Dependency Status



Appendix B: Survivor Probabilities for Gender and Dependency Status

Fig. B1

Survivor Probabilities for Gender

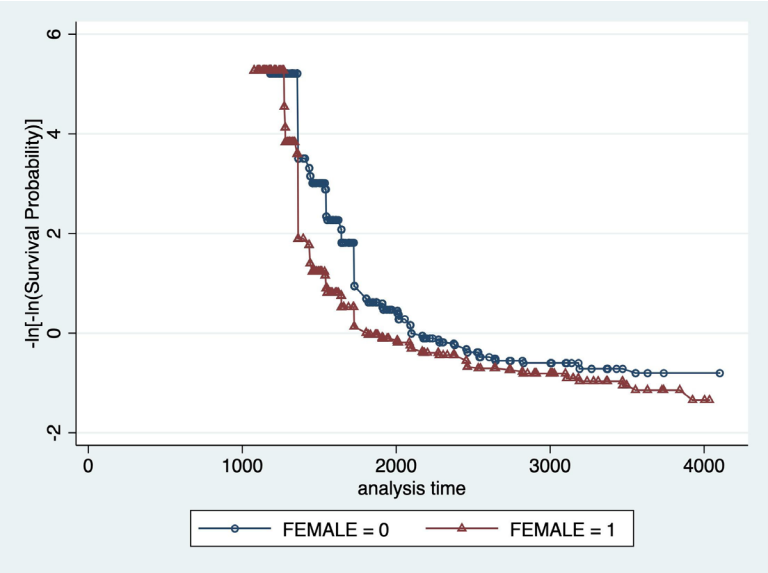
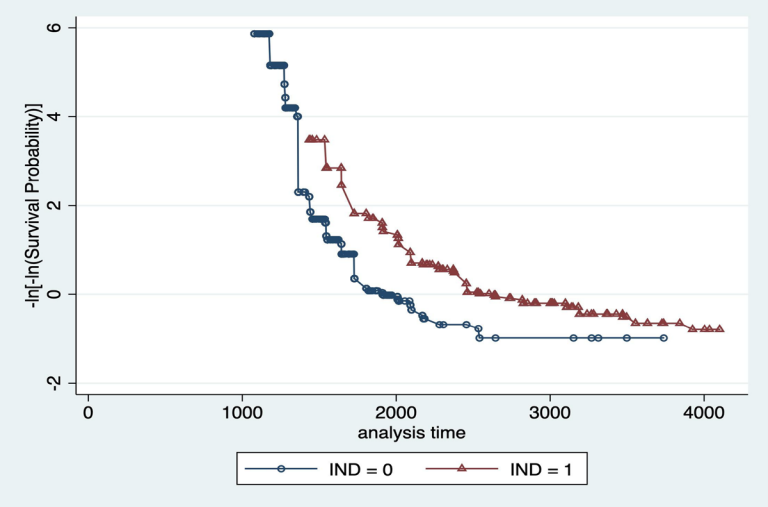


Fig. B2

Survivor Probabilities for Dependency Status



Appendix C: EHA Model for GMU Degree with Exact Partial Likelihood

EHA Base Model Estimates for Degree with Exact Partial Likelihood for Ties

Variables	H(t)	Std. Error	P-value
Lagged Bill	0.374	0.13	0.004
Female	1.680	0.24	0.000
Underrep. Ethnicity	1.285	0.20	0.102
Housing	1.471	0.34	0.096
Parent Education			
High School	1.385	0.52	0.382
Bachelor and beyond	1.097	0.40	0.801
Other	0.838	0.34	0.665
High School GPA	0.608	0.13	0.018
Independent	0.417	0.10	0.000
Residency	0.622	0.47	0.530
Total Income	1	0.00	0.989
Net Worth	1	0.00	0.858
Student Employment	1	0.00	0.188
Gift Aid	0.99993	0.00	0.034
Student Loan	1	0.00	0.165
Parent Loan	1	0.00	0.839
Cumulative College GPA	4.85	0.83	0.000

Note: Hazards rounded to nearest thousandth unless covariate statistically significant

Appendix D: EHA Model for GMU Degree with Time Interactions

Final EHA Model Estimates for Degree at GMU with Time Interactions

Variables	H(t)	Std. Error	P-value
Lagged Bill	0.409	0.13	0.006
Female	1.531	0.21	0.002
Underrep. Ethnicity	1.223	0.17	0.155
Housing	1.416	0.32	0.119
Parent Education			
High School	1.603	0.59	0.201
Bachelor and beyond	1.284	0.47	0.497
Other	1.105	0.45	0.805
High School GPA	0.692	0.14	0.071
Independent	0.361	0.09	0.000
Residency	0.704	0.51	0.626
Total Income	1.000	0.00	0.853
Net Worth	1.000	0.00	0.772
Student Employment	1.000	0.00	0.206
Gift Aid	0.9998	0.00	0.002
Student Loan	1.000	0.00	0.060
Parent Loan	1.000	0.00	0.847
Cumulative College GPA	3.893	0.63	0.000
Gift Aid x _t^2	1	0.00	0.013
Student Loan x _t^2	1	0.00	0.197

Note: Hazards rounded to nearest thousandth unless covariate statistically significant

Appendix E: GMU Degree Model Fit Comparisons

Fig. E1

GMU Degree Model Fit for Lagged Bill with TVC and Female Strata

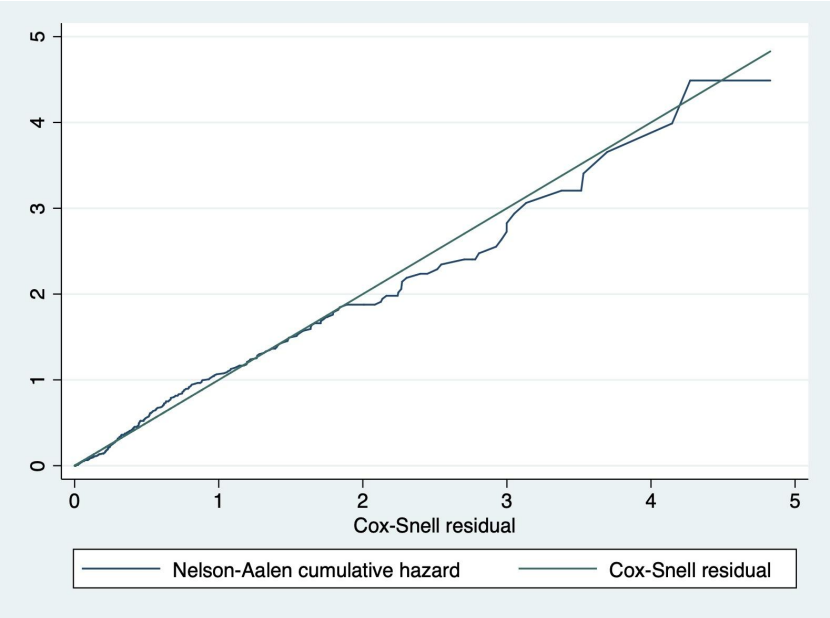
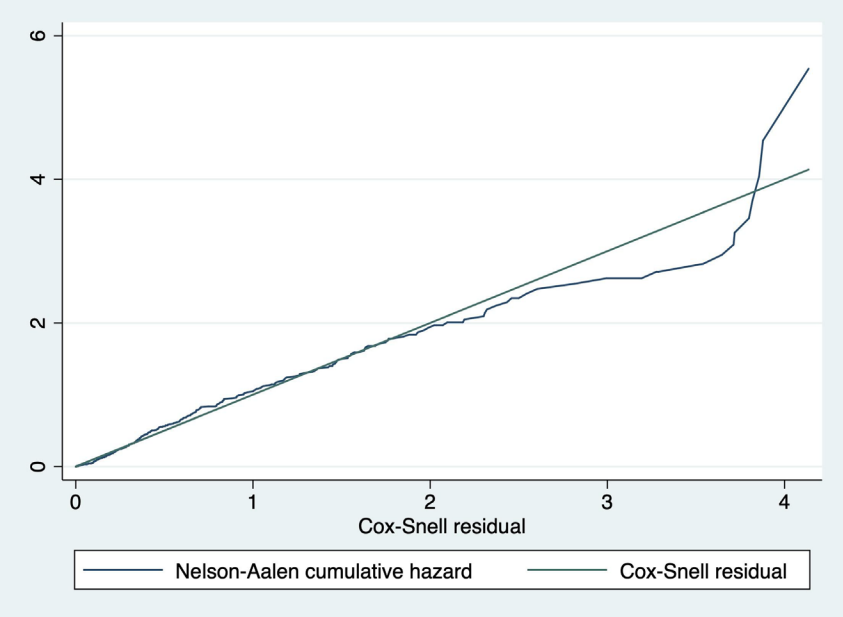


Fig. E2

GMU Degree Model Fit for Lagged Bill with Gift TVC and Risk Group Strata



Appendix F: EHA Model with Exact Partial Likelihood Stratified by Gender

EHA Base Model Estimates for Degree with Exact Partial Likelihood Stratified by Gender

Variables	H(t)	Std. Error	P-value
Lagged Bill	0.383	0.13	0.005
Underrep. Ethnicity	1.263	0.19	0.130
Housing	1.457	0.34	0.105
Parent Education			
High School	1.470	0.55	0.307
Bachelor and beyond	1.149	0.43	0.709
Other	0.900	0.37	0.797
High School GPA	0.639	0.14	0.035
Independent	0.452	0.11	0.001
Residency	0.561	0.42	0.443
Total Income	1	0.00	0.997
Net Worth	1	0.00	0.727
Student Employment	1	0.00	0.185
Gift Aid	0.99994	0.00	0.040
Student Loan	1	0.00	0.189
Parent Loan	1	0.00	0.961
Cumulative College GPA	4.53	0.78	0.000

Note: Hazards rounded to nearest thousandth unless covariate statistically significant

Appendix G: Baseline EHA Model with Marginal Likelihood

Baseline EHA with Marginal Likelihood for Degree at Any 4-Year College

Variables	H(t)	Std. Error	P-value
Lagged Bill	0.357	0.15	0.013
Female	1.470	0.17	0.001
Underrep. Ethnicity	1.116	0.14	0.377
High School GPA	1.22	0.23	0.287
Pell	1	0.00	0.941
Student Loan	1	0.00	0.704
Percent Time			
Three Quarter	0.357	0.11	0.001
Half time	0.613	0.12	0.009
Less than half time	0.776	0.19	0.308
Organization Type			
Private 4-year	0.459	0.09	0.000
Public 2-Year	0.092	0.02	0.000
Parent Education			
High School	1.178	0.34	0.569
College or beyond	1.236	0.35	0.450
Other	0.855	0.26	0.609
Income Group			
Middle	0.790	0.17	0.280
Low	0.726	0.12	0.049
Very Low	0.830	0.17	0.365
Extremely Low	0.723	0.12	0.045

Appendix H: EHA Model for Any Four Year with Interactions

Baseline EHA for Degree at Any 4-Year College with TVC and Interactions

Variables	H(t)	Robust Std. Error	P-value
Lagged Bill	0.943	0.68	0.935
Income Group			
Middle	0.791	0.17	0.283
Low	0.717	0.12	0.043
Very Low	0.830	0.17	0.367
Extremely Low	0.724	0.12	0.048
Lagged Bill#Income Group			
Middle	0	.	.
Low	0.251	0.29	0.238
Very Low	0	.	.
Extremely Low	0.694	0.67	0.694
Female	1.497	0.17	0.000
Underrep. Ethnicity	1.116	0.14	0.375
High School GPA	1.21	0.24	0.204
Pell	1	0.00	0.968
Student Loan	1	0.00	0.7765
Percent Time			
Three Quarter	0.356	0.11	0.001
Half time	0.633	0.12	0.015
Less than half time	0.752	0.19	0.254
Organization Type			
Private 4-year	0.373	0.11	0.001
Public 2-Year	0.045	0.02	0.000
Parent Education			
High School	1.153	0.33	0.621

Variables	H(t)	Robust Std. Error	P-value
College or beyond	1.210	0.34	0.505
Other	0.876	0.27	0.663
Organization Type x _t^3			
Private Four Year	1	0.00	0.204
Public Two Year	1	0.00	0.000
Lagged Bill x _t^3	1	0.00	0.509

Appendix I: Any Four Year Degree Model Fit Comparisons

Fig. I1

Any Four Year Degree Model Fit for Lagged Bill with Organization Type TVC

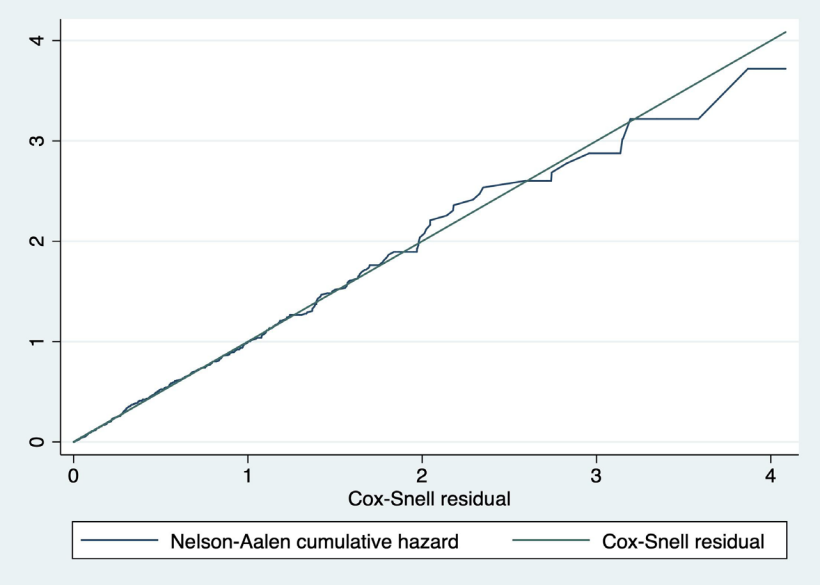


Fig. I2

Any Four Year Degree Model Fit for Lagged Bill with Fixed Effects for Risk Group

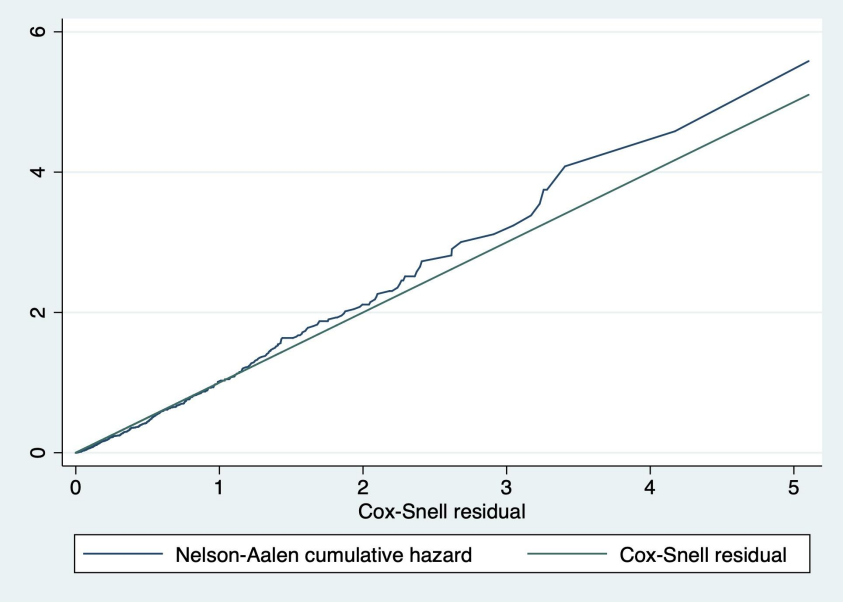
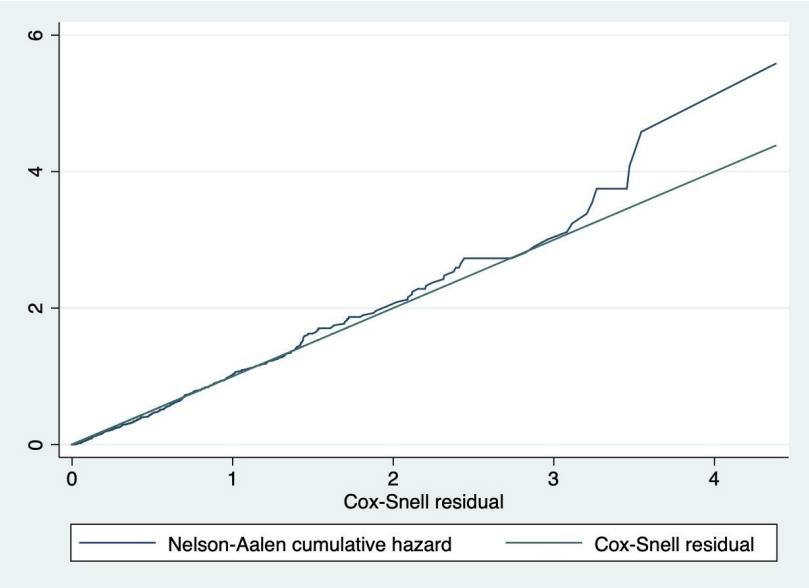


Fig. I3

Any Four Year Degree Model Fit for Lagged Bill with Fixed Effects, TVC, and Interactions of Aid and Income



Appendix J: Original Study Variables

Original Description of Study Variables

Variables	Definition	Model A	Model B	Reference Group	Variable Classification
Billed aid	Total billed financial aid amount by term at Golden Mountain as result of Return to Title IV policy, measured in dollars	X	X	-	Time-varying
Student background					
Female	Gender reported on FAFSA from freshmen year	X	X	Male	Time-independent
Underrepresented ethnicity	Students' primary ethnicity is not White or Asian as coded in the student information system	X	X	White/Asian	Time-independent
Parent education	The highest level of education recorded for parent(s) on the student's FAFSA from freshmen year	X	X	Jr. High	Time-independent
Pre-college preparation					
Cumulative HS GPA	High school GPA measured on 4.0 scale as reported on student's admissions application	X	X	-	Time-independent
College experience					
College GPA	Measured by term on 4.0 scale from GMU student information system by term	X		-	Time-varying
Cohort year	Year recorded of first fall term as an enrolled freshmen at GMU	X	X	2007	Time-independent
Academic credits	Sum of earned credits earned by term	X	X	-	Time-varying
Financial Factors					
Total family income	Total income as measured on FAFSA by aid year in dollars	X	X	-	Time-varying
Total assets	Sum of cash, savings, and investment net worth as reported annually on the FAFSA	X	X	-	Time-varying

Original Study Variables Continued

Variables	Definition/Coding	Model A	Model B	Reference Group	Variable Classification
Independent	Output as determined by student response to statutorily defined dependency questions on FAFSA	X	X	Dependent	Time-varying
Federal grant	Sum of federal grants in dollars received by the student during each enrollment term, including Pell Grant, Supplemental Education Opportunity Grant, Vet Benefits, and Other Fed. Grant	X		-	Time-varying
Pell Grant	Sum of Pell grant in dollars received by student during each enrolled term at any institution		X	-	Time-varying
State grant	Sum of state grants in dollars received by the student during each enrollment term, including State Grant, Chafee Grant, Other State Grant Aid	X		-	Time-varying
University grant	Sum of university grants in dollars received by the student during each enrollment term, including Tuition Grant, Other University Aid	X		-	Time-varying
Other gift aid	Sum of gift aid in dollars received by the student during each enrollment term from private agencies e.g. scholarships, fee remissions, etc	X		-	Time-varying
Subsidized loan	Sum of federal subsidized loan received by the student by term, in dollars	X	X	-	Time-varying

Original Study Variables Continued

Variables	Definition/Coding	Model A	Model B	Reference Group	Variable Classification
Unsubsidized loan	Sum of federal unsubsidized loans received by the student during each enrollment term measured in dollars, including Unsubsidized Stafford and additional Unsubsidized Stafford	X	X	-	Time-varying
Perkins loan	Sum of federal Perkins loan received by the student by term, in dollars	X	X	-	Time-varying
Student employment	Student earnings reported on the future year FAFSA received by the student, in dollars	X	X	-	Time-varying
Federal parent loan	Sum of federal parent (PLUS) Stafford loans received to the student's billing account during each enrollment term, in dollars	X	X	-	Time-varying
Private loan	Sum of private loans received by the student during each enrollment term, in dollars	X		-	Time-varying
Residency	Residence for tuition purposes will be coded from student info. system	X		Resident	Time-independent
Housing status	Student's housing status will be coded by aid year based on the student budget	X		On-campus	Time-varying
Organizational Effect					
Organization type	Institution type will be coded using National Student Clearinghouse definitions.		X	4-year public	Time-independent
Time in College					
Running months enrolled	Measured in weeks by enrollment spell	X	X	-	Time-varying
Running career weeks	Measures in weeks since start of observation	X	X	-	Time-varying

Original Study Variables Continued

Variables	Definition/Coding	Model A	Model B	Reference Group	Variable Classification
Interaction Effects					
Billed aid x Income	Total income will be interacted with amount Billed at Golden Mountain University	X	X	-	Time-varying
Billed aid x Months Enrolled	Months enrolled will be interacted with amount billed aid at Golden Mountain University	X	X	-	Time-varying

Appendix K: Data Decisions

When I conducted the study, I had to make decisions on the data to improve efficacy, stability, internal validity, and address limitations of tracking items across institutions in the second model. In this appendix I describe my decisions on grouping and recoding covariates, as well as some details on tests I used to determine the final set of covariates for analysis. Decisions were made in two phases: 1) prior to completing analysis as part of model design, and 2) after initial survival analysis failed to produce measureable results for the key independent variable of billed aid.

Prior to Analysis

As part of data collection I found degree completion rates across ethnicities were consistent between national surveys and the home institution where the sample was drawn. Shapiro et al. (2017) found that White and Asian students completed bachelors degrees at similar rates. I decided to code ethnicity as a binary variable, lumping students whose primary ethnicity was White or Asian as the reference group and all others as 1. These other ethnicities included students who identified as Black, Latino, Native American, and Unknown. Similar to gender, these categories are defined by what is coded for each student in the student information system. Both gender and ethnicity are self-reported by the student.

I could not track reported income across institutions for the second model which tracked student enrollment across institutions and across time. This necessitated locking students in a category of income to describe their family financial strength. Further, as noted earlier in the study, a student's transition to independent status masked family financial strength. I decided to group total income into categories using the CA Department of Housing and Development (2011) tiers for the second model. I

categorized a student into a category based on their median reported income while at Golden Mountain University. The CA Department of Housing and Development was selected based on it being a regionally focused entity with a mission of supporting safe and affordable housing. They conduct research and surveys in California, and they categorize income as part of this process. With many definitions of income level, the categories presented by this agency represented the best measure as they are a unit focused on the state where the university is located and where a majority of the sample lived prior to joining the university.

Subsequent to Initial Survival Analysis

The original data set included nearly thirty different covariates based on what was found to affect student enrollment behavior (Alon, 2011; Chen, 2008; DesJardins et al., 2010; Ishitani, 1999), as well as variables which affect students' college finances. Initial analyses produced a lack of measure of the key independent variable, Billed Aid. A histogram revealed a low frequency of billed aid events as compared to non-billed periods (less than 6%). Amounts also varied widely. This suggested model misspecification. Additionally, the large number of covariates, small incidence of treatment and moderate number of degree events were basis for my exploration of data diagnostics.

I ran several diagnostic tests to determine model build in this second phase of data decision making. This included a power analysis, regression of covariates against time to test for multicollinearity, log rank tests for differences between groups, and evaluating Chronbach's alpha and principal component analysis to measure internal consistency. A base power analysis indicated that as correlation increased in the model, power decreased. I had to define level of correlation among the covariates. I achieved this by

regressing covariates on time and conduct correlation tests (Allison, 2019). This analysis showed variables which were moderately to highly correlated, including state gift aid with federal gift aid, total income and federal gift aid, and cohort with dependency status and parent education. Cohort did not show statistical relevance after reviewing survivor functions across time. Given cohorts were also moderately correlated with other variables, I removed this covariate from the model. Additionally, the R2T4 policy indicated state aid must match tuition at the campus, so any reduction to that aid type would not be represented in the financial aid bill. I removed state gift aid from the model given it has not variation and due to its correlation with federal.

Additionally, I ran a principal component analysis (PCA) to better understand the internal validity of the covariates in the model. Total income and federal grant showed moderate/high correlation in the prior test for multicollinearity. Through PCA I confirmed that federal grant and total income, if removed, would decrease inter-item correlation but both were also important to explanation of variance. PCA also indicated that most of the variance could be captured by eight components, a substantially lower number than my original start variable set. One way to retain the information provided by both federal grant and total income while reducing dimensionality was to combine like covariates measured on the same scale (Allison, 2019; Singer & Willett, 2003). I decided to combine all gift aid sources that remained, including federal, university and other gift aid. To maintain consistency among aid variables, I did the same consolidation with student loan variables, including subsidized, unsubsidized, Perkins, and private loans. These covariate groups were measured in dollars and accounted for similar program types.

As mentioned in the Model Results section, simultaneity was the primary issued with the lack of measure for the key independent variable. The modification of the enrollment time based on the withdrawal (treatment) date produced a perfect prediction effect. The resolution for this issue was to lag the variable one time period (Yamaguchi, 1991) and to increase frequency I transformed Billed Aid to a binary variable to indicate if a student experienced a bill greater than zero in the prior enrollment period.